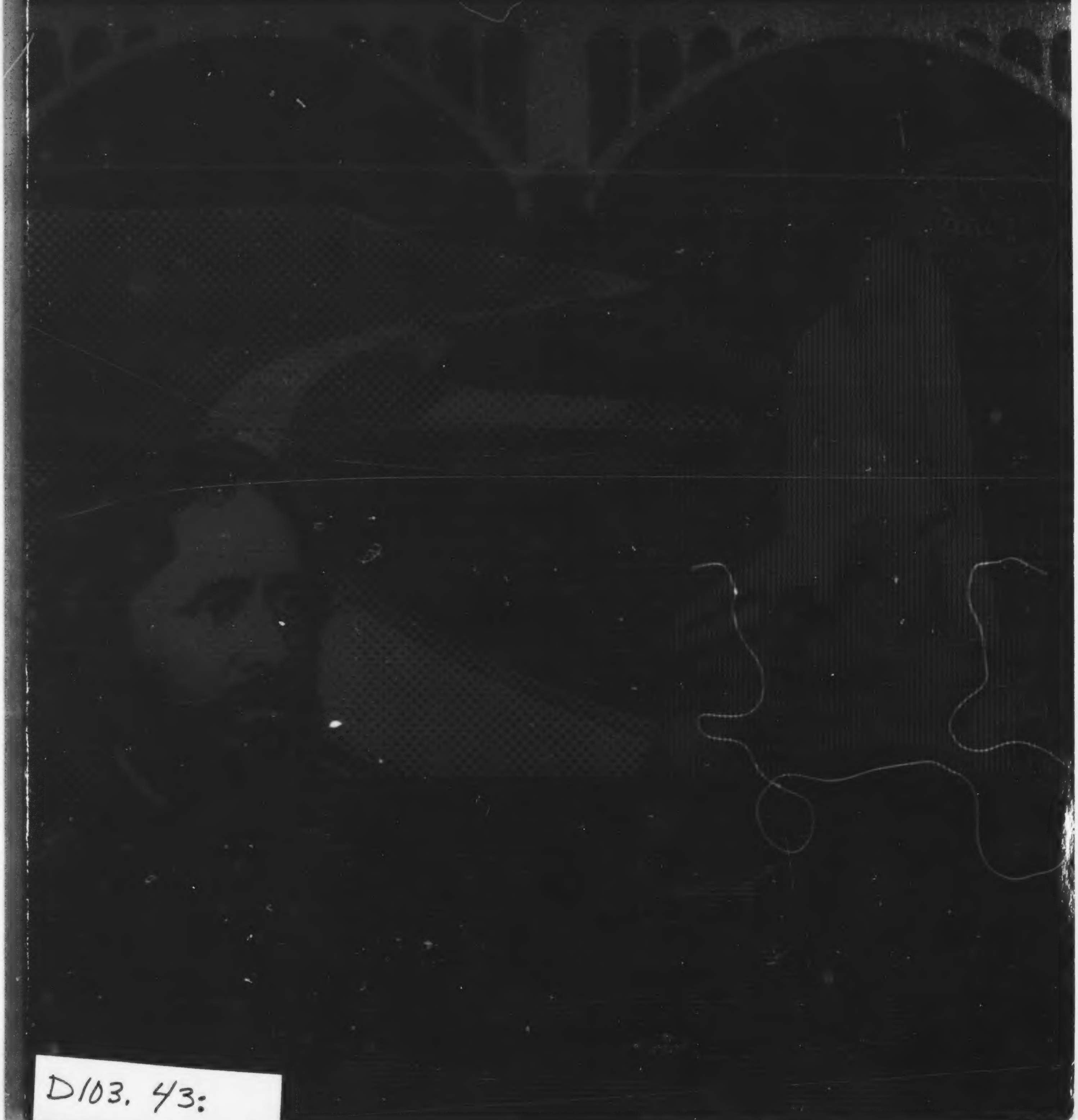
360-1-21

US Army Corps
of Engineers

The History of the US Army Corps of Engineers



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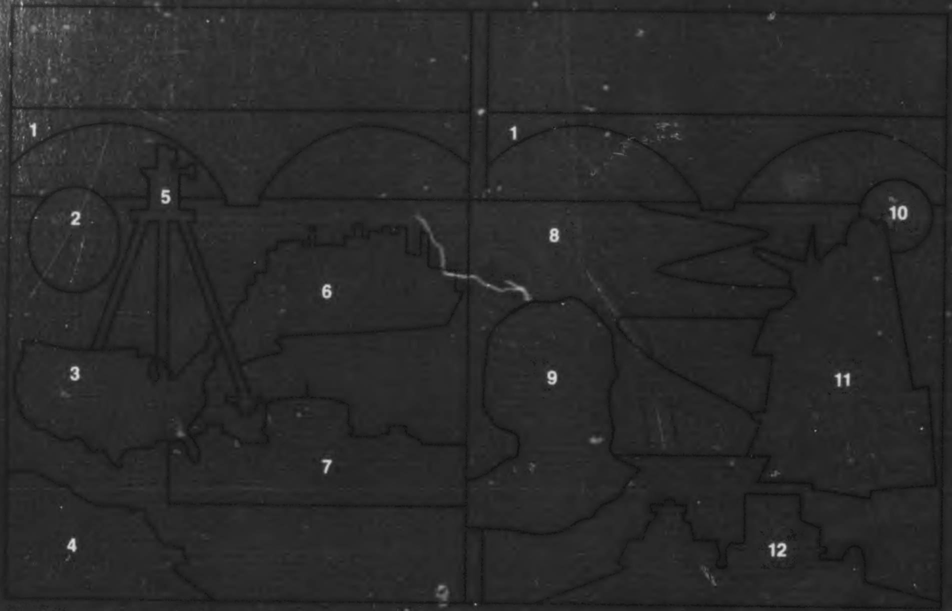

Cover

1 Key Bridge, Washington, D. C., completed in 1923 by the Corps

2 Stephen H. Long, Western explorer and pioneer in improving Ohio River navigation

3 Ohio and Mississippi river systems

4 Crossing the Seine on a ponton bridge, 1944

5 Transit used in surveying

6 Steamboat *Golden Eagle* on the Cumberland River

7 U.S. Capitol dome under construction, 1857

8 Tennessee-Tombigbee Waterway completed by the Corps in 1985

9 John C. Frémont, leader of Western exploration by the Topographical Engineers

10 The Essayons Button distinctive insignia of the Corps of Engineers

11 Space Shuttle *Enterprise* ready for liftoff

12 Grader and roller at work on World War II airfield

This pamphlet supersedes EP 360-1-12, SEP 78 and EP 360-1-13, MAR 78.

The History of the US Army Corps of Engineers

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Foreword

For over 200 years the Corps of Engineers has served the nation. On the battlefield engineer officers have been instrumental in achieving success since the early days of the Revolutionary War. In peace their activities have been no less valuable. Since 1824 the Corps has been charged with maintaining the navigability of the nation's rivers. In this century, it became the primary federal flood control agency, and Corps dams provide a significant share of the nation's hydropower.

The evolution of the Corps is an integral part of the development of the United States. I hope that readers will gain from this history an appreciation for the economic, political and technological factors that shaped the modern Corps of Engineers. We in the Corps, both military and civilian members, are proud of our many contributions to the nation and look forward with confidence to continued service during war and peace.

E. R. Heiberg III
Lieutenant General, USA
Chief of Engineers

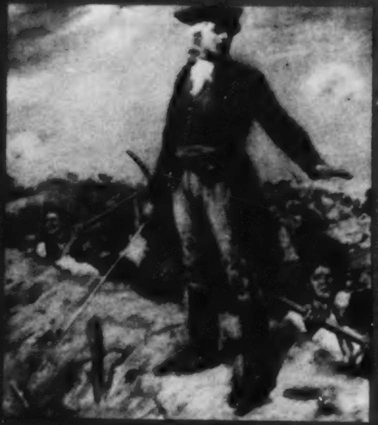
[illegible]

[illegible]

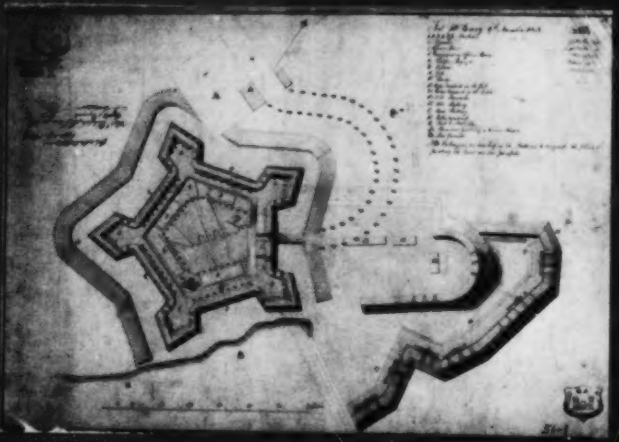
1781 ● Siege of Yorktown

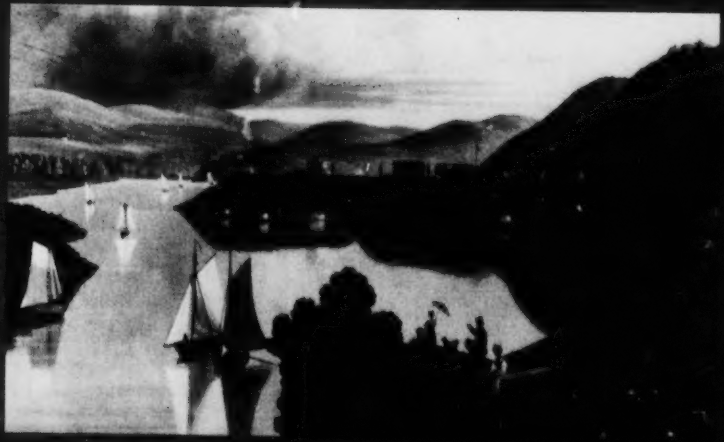
1783 Corps of Engineers mustered out of service

1794 Corps of Artillerists and Engineers established



● "Col. William Prescott at the Battle of Bunker Hill," painting by Frederick C. Yohn.



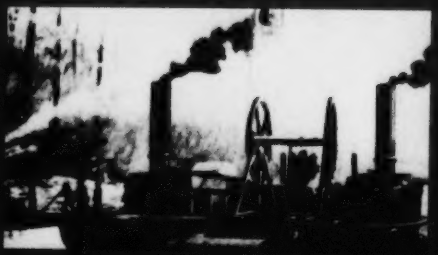


[illegible]

[illegible] • Frémont's expeditions

1846 • Creation of Engineer troops; Mexican War

1853–55 • Pacific Railroad Surveys



U.S. [illegible]

• Cavalry charge during Mexican War

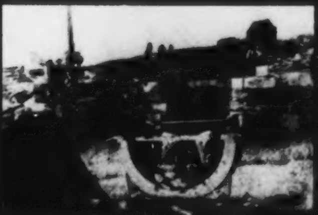
• Joining of Central Pacific and Union Pacific Railroads, Promontory Point, Utah.

UNITED STATES OF AMERICA
5 5
FIVE CENTS
POSTAGE FIVE CENTS

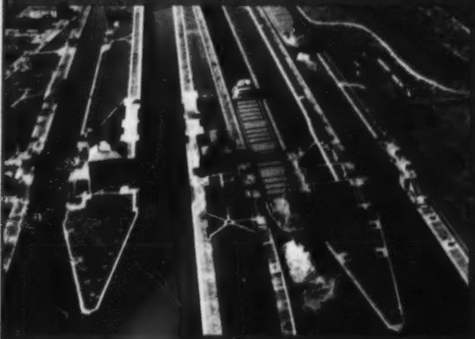
1853 ● Washington Water Supply

1855 ● Sault Ste. Marie [illegible]

[illegible]



Soo Locks, Sault Ste. Marie, Michigan, today



[illegible]

[illegible]

[illegible]

[illegible]

1864 ● Army Engineers in the Army of the Potomac construct a 2,200-foot pontoon bridge over the James River, probably the longest pontoon bridge in the history of warfare

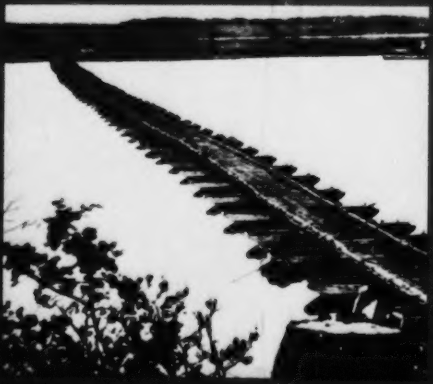
1866 Engineer School of Application founded

1870s ● Barlow, Jones, and Ludlow expeditions to Yellowstone

1879 ● Creation of Mississippi River Commission

1882 Mississippi floods; first Corps emergency operation

● Major General Quincy A. Gillmore, first president of the Mississippi River Commission



● [illegible]

● Falls in Yellowstone

● [illegible]

1884 ● Corps completes reservoirs at Winnibigoshish, Leech Lake, and Pokegama, Minnesota, the first reservoirs constructed by the [illegible]

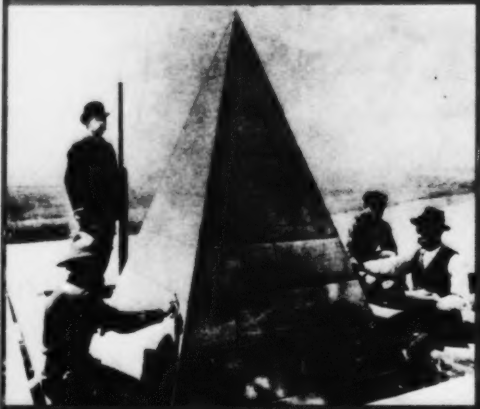
1884 ● Corps finishes Washington Monument [illegible]

1885 Davis Island Lock and Dam, Ohio River [illegible]

1888 Engineer [illegible]

1897–19 ● [illegible]

[illegible]



● Workmen pointing tip of Washington Monument

THE BIRTHDAY
GEORGE WASHINGTON
[illegible]
Great National Monument
WASHINGTON!

[illegible]

[illegible]

● Timber dam at Leech Lake

[illegible]

[illegible]

[illegible]

1914 ● Panama [illegible]

1917 ● First Flood Control Act

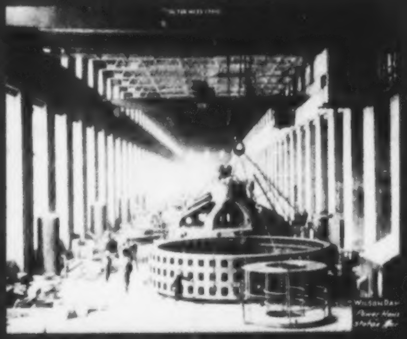
1917–18 ● U.S. involvement in World War I

1919 Engineer School moved to Camp Humphreys (later renamed Fort Belvoir)

● High water in Hickman, Kentucky 1912

● [illegible] Canal

● Engineering survey party in Sussex, England, 1918.


WILSON DAM
Power House

PHARMACY

[illegible]

[illegible] agency

1940 ● Corps takes over airfield construction

1941 ● Corps becomes Army's construction agency; construction of the Pentagon begins. The Corps finishes construction of the $80 million building in less than two years. It has twice the office space of the Empire State Building.

1941–45 ● U.S. involvement in World War II

1942 ● Corps begins construction of the Alaska Highway

[illegible]

U.S. ENGINEERS
PASSAMAQUODDY TIDAL POWER PROJECT
President Roosevelt
and Lt. Col. Fleming inspecting
tidal model of project.

ROOSEVELT
RHINE RIVER BRIDGE
LENGTH
COMPLETED APRIL 1945
1146 ENGR C GP
252 ENGR C BN
250 ENGR C BN
FRANKLIN D ROOSEVELT
ONE WAY 70
TWO WAY 40

● Sign at Franklin D Roosevelt Memorial Bridge across the Rhine, Germany April 22, 1945

● Clearing land for Alaska Highway

1942–44 ● Construction of Ledo Road

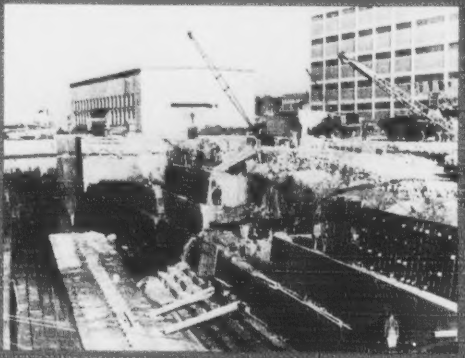
1944 1944 Flood Control Act [illegible] develop recreation [illegible] ects; it also autho[illegible] water projects in the [illegible] accordance with the Pick-Sloan [illegible]

1946 Corps begins VA Hospital [illegible] program

1946–49 ● Corps supervises [illegible] Greece

1950–53 ● Korean Conflict

1950s ● Corps builds air force bases in Morocco



● Reconstruction at Piraeus Harbor, Greece, February 1948

Historical Division, Corps of Engineers

● Elephant-mounted survey party and bulldozer on the Ledo Road, North Burma

● Hangar at Nouasseur, Morocco, December 1952

Historical Division, Corps of Engineers

● Combat engineers lay wire along defense perimeter, Korea, 1952

1952 SAC base construction begins

1952 Nuclear power program begins

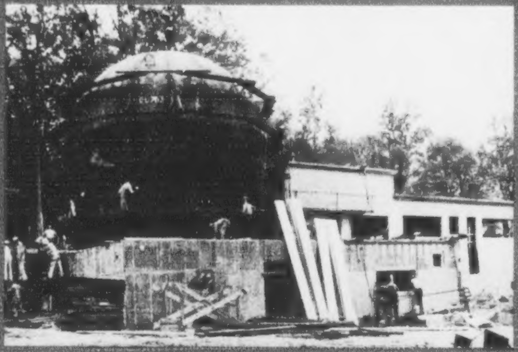
1955–58 Corps builds U.S. section of St. Lawrence Seaway

1958–63 ICBM base construction

1961 NASA support begins

1963 Completion of Old River Control Structure

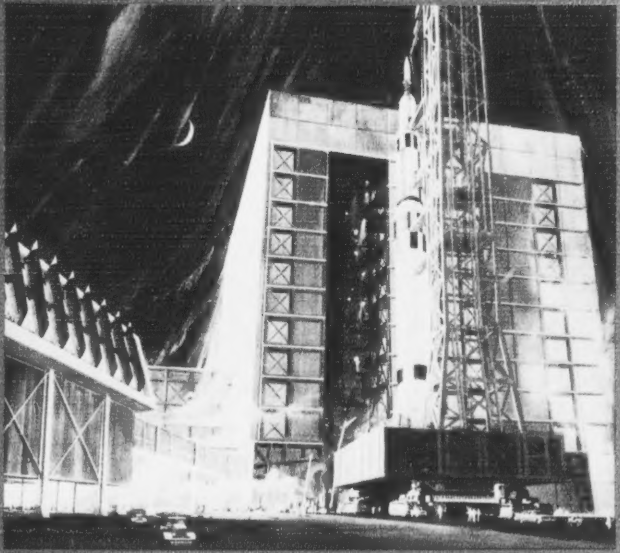
1960s AID support overseas



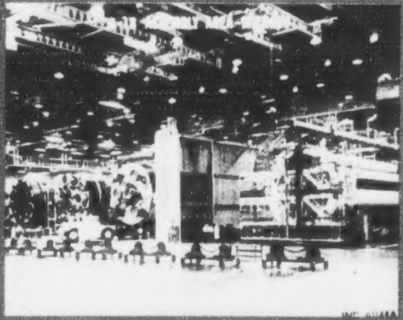
Public Affairs Office, Corps of Engineers

Construction of SM-1 Nuclear Power Plant, Fort Belvoir, Virginia

Vertical Assembly Building, Saturn complex 39.



Public Affairs Office, Corps of Engineers



Public Affairs Office, Corps of Engineers

ICBM assembly area.

1962 Corps loses control of Engineer School and Engineer troops

1965–72 ● Engineers in Vietnam

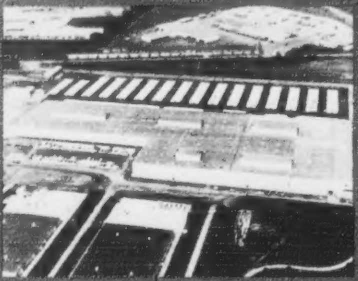
1969 National Environmental Policy Act passed

1971–76 ● Bulk mail handling centers constructed for the Post Office

1971 ● Tennessee-Tombigbee Waterway begun

1972 ● Clean Water Act charges Corps with regulation of dredge and fill activities in the nation's wetlands

1974 Corps is assigned Army's responsibility for facilities engineering



● Cincinnati Bulk Mail Center.

● Marco Island, Florida, dredge and fill project.

● Tennessee-Tombigbee's Gainesville spillway under construction.

● Probing for enemy mines in Hai Van pass, March 1968

1976 Corps [illegible]

1976 • Middle East [illegible]

1977 [illegible]

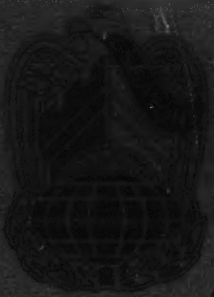
1979 • Corps becomes a major [illegible] world

1978–82 • Israeli airbase construction

1982 Design and construction effort begun in support of EPA's Superfund cleanup program

1985 • Tennessee-Tombigbee Waterway completed

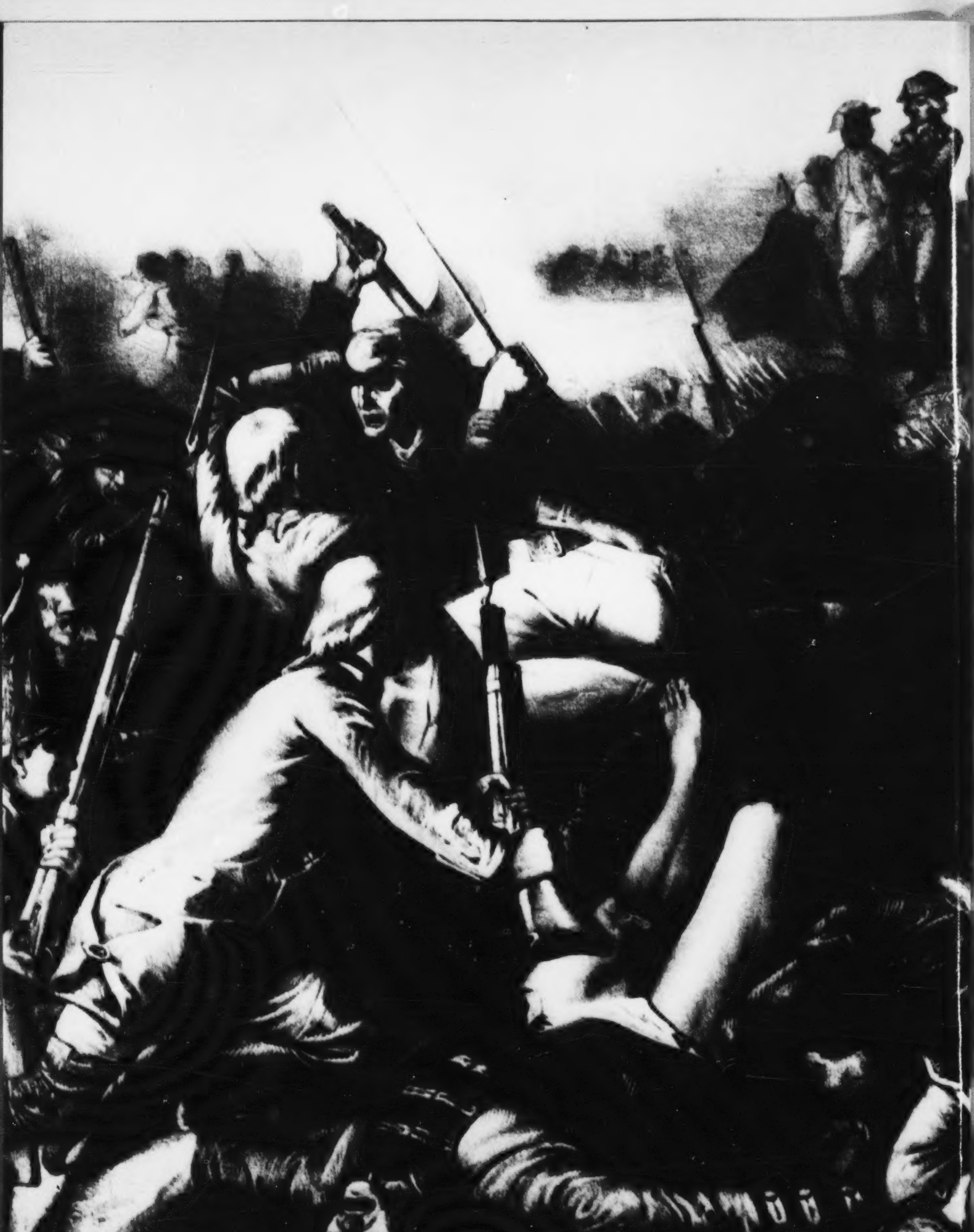
• Jet landing at Ovda Airbase.



• Distinctive unit insignia for U.S. Army Corps of Engineers.

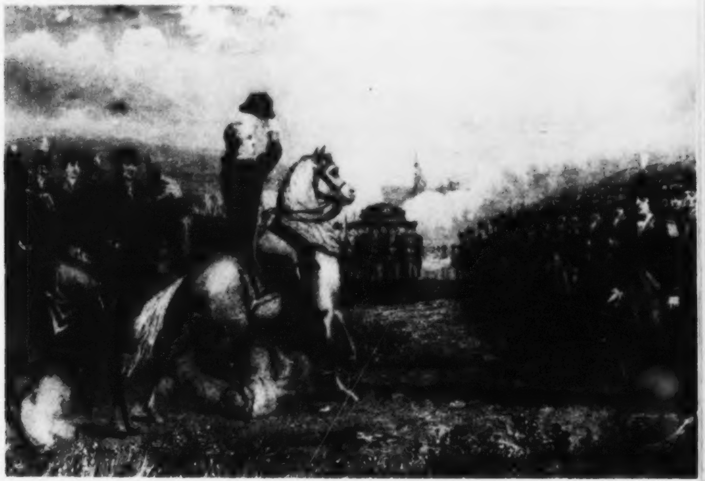
• Main mosque, King Abdul Aziz Military Academy, Saudi Arabia.

• Tennessee-Tombigbee Waterway dedication in Mobile, Alabama, June 1985.

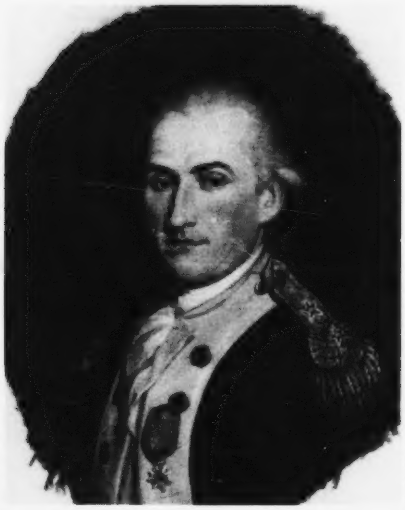


The Revolutionary War

Washington assumes command at Cambridge, Massachusetts.



National Archives



Independence National Historical Park Collection

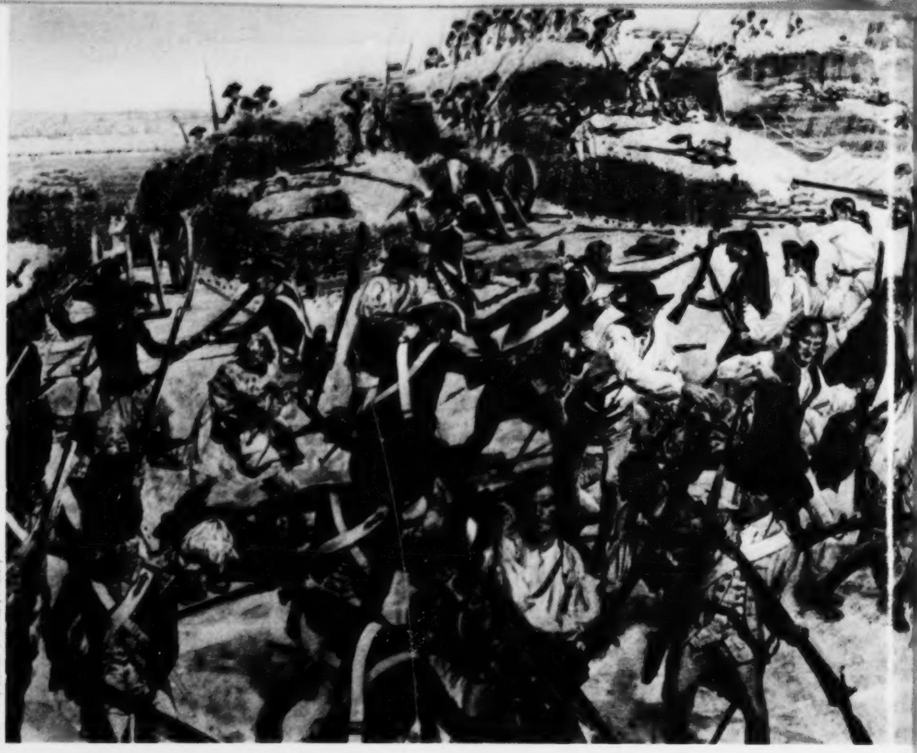
Major General Louis Duportail, by Charles Willson Peale.

When Congress organized the Continental Army on June 16, 1775, it provided for a Chief Engineer and two assistants with the Grand Army and a Chief Engineer and two assistants in a separate department, should one be established. Colonel Richard Gridley of Massachusetts, one of the few colonials with experience in the design and construction of batteries and fortifications, became General George Washington's first Chief Engineer. Another native of Massachusetts, Rufus Putnam, who succeeded Gridley as Chief Engineer in 1776, was one of his assistants while the Army remained in Boston.

From the start the predominantly defensive nature of the war convinced Washington he would need even more trained engineers, but he was continually frustrated in his efforts to find them. Qualified engineers were scarce because formal schooling in siegecraft, the erection of field fortifications, and technology was practically non-existent in America at the time. In response to Washington's plea for more engineers, Congress turned to France, which was an enemy of Britain and the center of technical education in Europe. The French also had a long tradition of military engineering. Beginning in 1776 Frenchmen began to arrive in America to serve as engineers. Before the end of 1777 Congress had promoted one of them, Louis Duportail, to brigadier general and Chief Engineer, a position he held for the duration of the war. Frenchmen, joined by other foreigners, dominated the ranks of the engineers throughout the war.

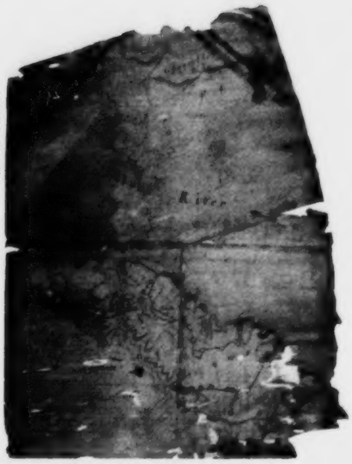
When Duportail took command of the engineers he renewed the pressure begun by his predecessor to establish a permanent, separate and distinct engineering branch of the Army. His proposal included a provision for companies of engineer troops to be known as Sappers and

French artist's lithograph portrays action at Yorktown.



Bunker Hill, June 17, 1775, by H. Charles McBarron.

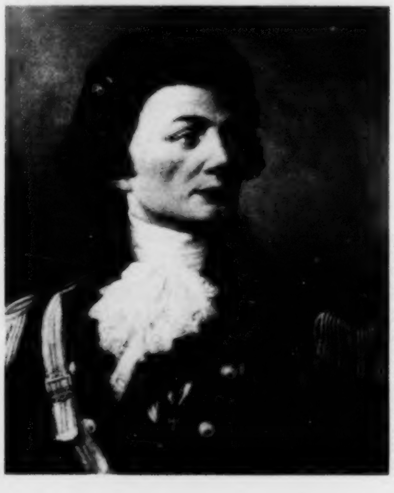
U.S. Army Center of Military History



National Archives

Plan of attack for Yorktown, drawn by Jean Baptiste de Gouvion, October 29, 1781.

Thaddeus Kosciuszko, by Charles Willson Peale.



Independence National Historical Park Collection

Yorktown, October 14, 1781, by H. Charles McBarron.

U.S. Army Center of Military History

Miners and to be officered by Americans. From their ranks would come the engineer officers to replace the French when they returned home.

On May 27, 1778, Congress finally authorized three companies of Sappers and Miners who were to receive instruction in erecting field works—a first step toward technical education—and were to direct fatigue parties, repair damaged works and erect new ones. Recruitment continued for more than two years with activation of the three companies on August 2, 1780. Meanwhile on March 11, 1779, Congress passed a resolution which formed the engineers in the Continental Army into the Corps of Engineers Duportail had sought.

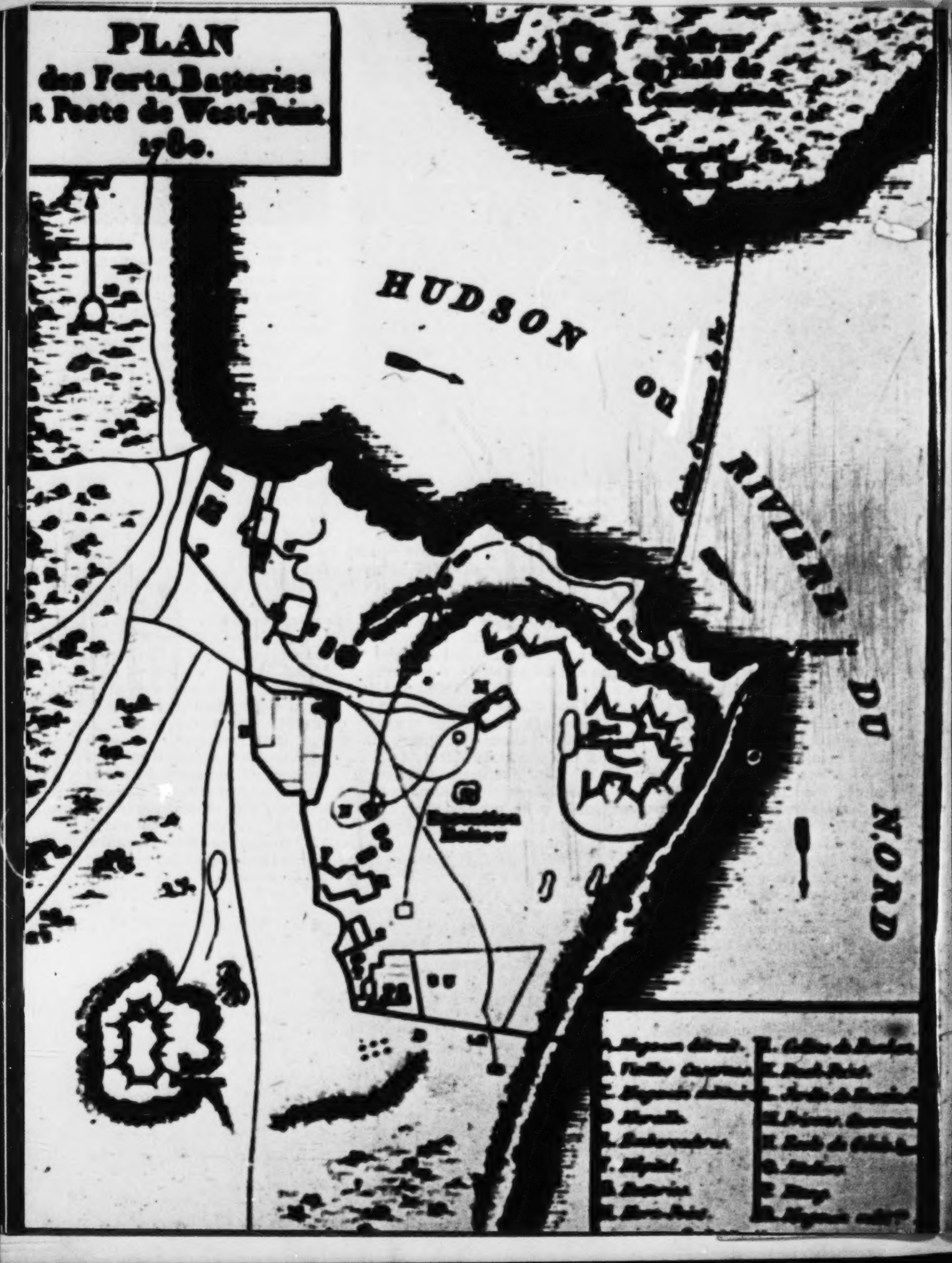
Despite the shortage of engineers and the delay in forming companies of engineer troops, the Army's engineers made numerous contributions to the war. Engineer officers reconnoitered enemy positions and probable battlefields, wrote useful reports based on their observations, oversaw the construction of fortifications and drew detailed maps for commanders. Congress relieved some of the mapping burden when it appointed Robert Erskine as Geographer of the Army in 1777. Erskine and his successor, Simeon DeWitt, employed several assistants as did Thomas Hutchins, whom Congress appointed as Geographer for the Southern Army in 1780. Following this precedent, Congress added Topographical Engineers to the Corps of Engineers in 1813 and created a Topographical Bureau in the Engineer Department in 1818.

Engineer officers often took action which helped achieve decisive results. One such incident occurred during the siege of Boston. In February 1776, General Washington's council of war decided to draw the British out of Boston by erecting works on the unfortified Dorchester Heights. To achieve surprise the Army needed to move quickly, but the ground was frozen more than a foot deep. Colonel Rufus Putnam, Washington's Chief Engineer, offered an innovative solution to the problem. He recommended using chandeliers—wooden frames filled with bundles of sticks—to raise the walls above ground. To the astonishment of the enemy, the Continentals erected the chandeliers in a single night (March 4-5). When it was determined three days later that the position could not be taken, the British found that their hold on Boston was no longer tenable and evacuated the city.

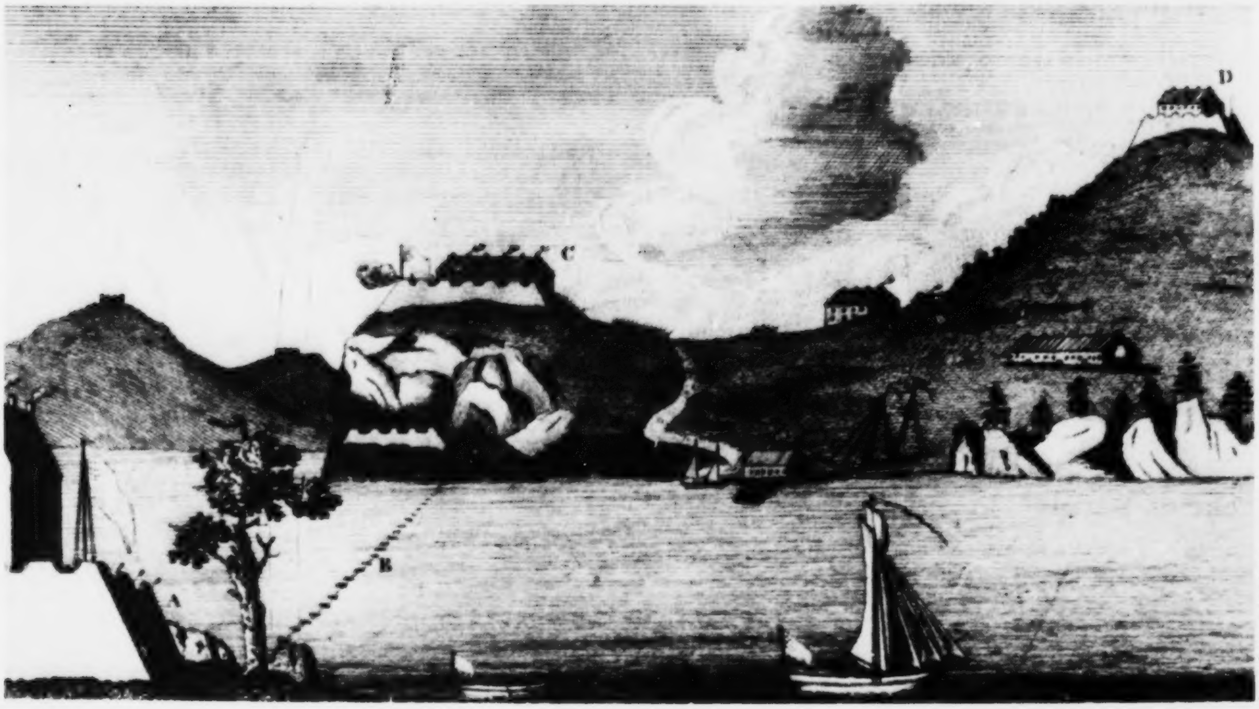
The next year Lt. Col. Thaddeus Kosciuszko, a native of Poland commissioned as an engineer officer in the Continental Army, placed obstructions that significantly impeded Burgoyne's advance toward Albany after the fall of Fort Ticonderoga. Later Kosciuszko helped design the network of defenses at West Point and in 1781 he was instrumental in allowing Nathaniel Greene's Southern Army to evade capture by the enemy. During the difficult winter months of 1777-1778, Washington followed Duportail's advice: wear down the British at Philadelphia while avoiding attack. This strategy helped preserve the Army.

The Corps of Engineers and its companies of Sappers and Miners enjoyed their finest hour in October 1781 at Yorktown, where Washington conducted a siege in the classical manner of Sebastien de Vauban, the great French master of siegecraft. Engineer officers, numbering 13 in the combined French and American armies, performed crucial reconnaissance, and with the 50 men in the Sappers and Miners, planned and executed field works. In addition the Sappers and Miners assembled fortification materials, erected gun platforms, transported cannon and ammunition, and cleared the way for the decisive infantry assault on Redoubt 10. After the battle Washington cited Duportail for conduct which afforded "brilliant proofs of his military genius, and set the seal of his reputation."

When the Revolution ended in 1783, a debate followed on the nature of the peacetime establishment of the Army. Proposals regarding the engineers varied. They included a union of the engineers with the artillerists and the establishment of an academy to provide training. Retaining an engineer presence in the Army was seen as necessary by those who favored a centralized system of fortifications. Engineers would be needed to build and maintain them. Two arguments in favor of retaining the engineers drew directly upon Revolutionary War experience. Without a permanent, trained Corps of Engineers, it was maintained, the new nation would be forced to call on foreigners again in time of war. Moreover, as the Revolutionary War had demonstrated, it was extremely difficult to put together an effective technical organization in a short time. But Congress did not approve a peacetime Army and with that decision went any hope of retaining the Corps of Engineers. By the end of 1783 the Corps and its companies of Sappers and Miners had mustered out of service.

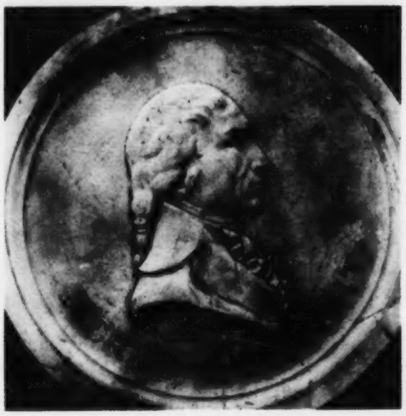

PLAN
des Forts, Batteries
et Poste de West-Point
1780.
HUDSON
OU
RIVIÈRE
DU NORD

Union with the Artillerists



West Point in 1783. Wood engraving by C. Tiebout from a drawing by H. Livingston.

U.S. Military Academy Library



Likeness of Pierre Charles L'Enfant.

National Archives

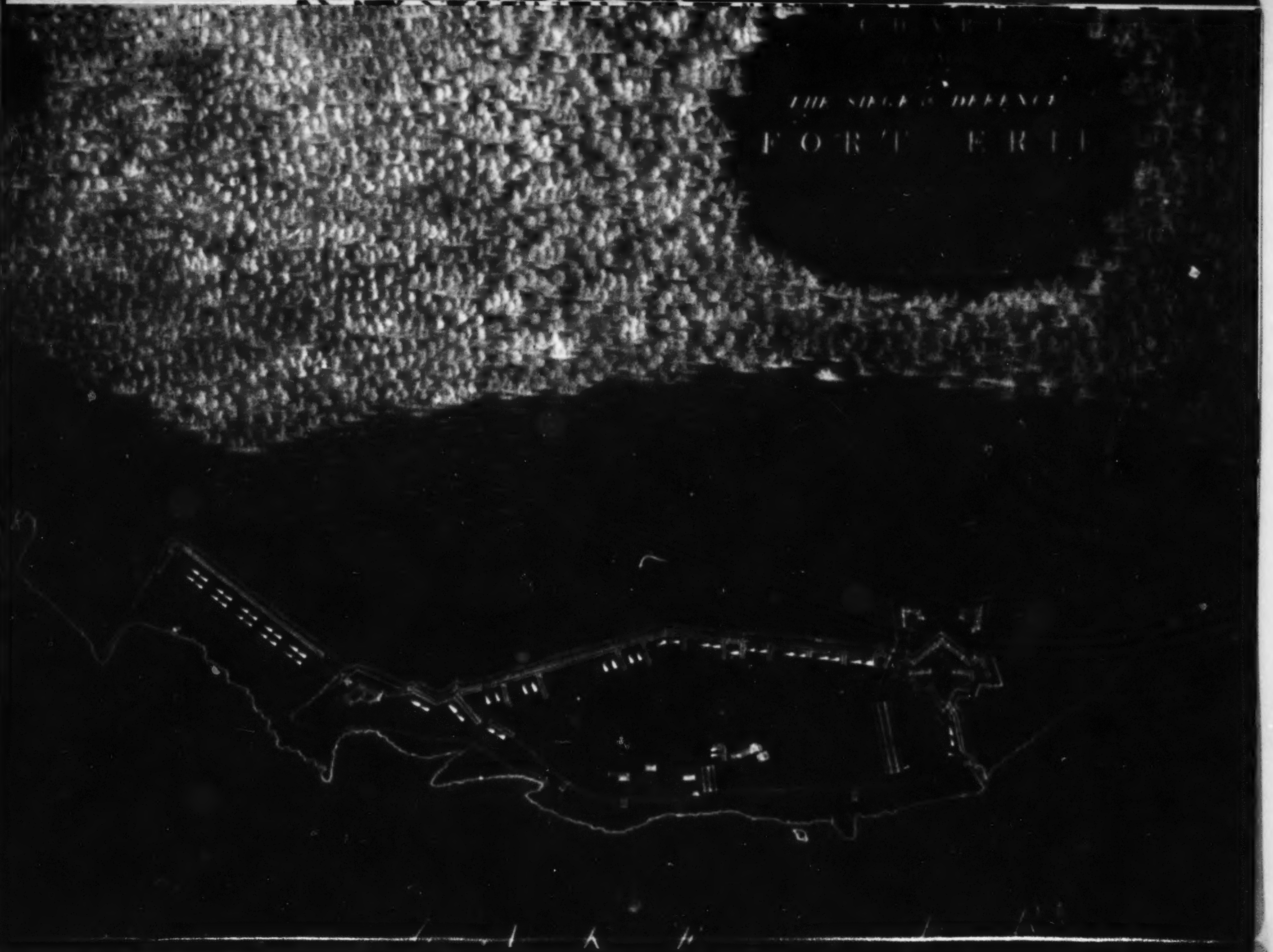
When the new government under the Constitution was launched in 1789, Secretary of War Henry Knox recommended "a small corps of well-disciplined and well-informed artillerists and engineers." Nevertheless, no engineers served the Army until March 1794 when war threatened with Britain. At that time Congress authorized President Washington to appoint temporary engineers to direct the fortification of key harbors. Among those named were Pierre L'Enfant and Major Stephen Rochefontaine, another veteran of the Revolutionary War Corps of Engineers.

The following May, heeding the much earlier advice of Duportail and others, Congress established a single Corps of Artillerists and Engineers consisting of one regiment. Rochefontaine assumed command of the new Corps. At the same time a school to train Army officers took shape at West Point, New York.

As war threatened with France in 1798, Congress added a second regiment of artillerists and engineers. In 1802 Congress reduced the military establishment again and separated the artillerists and engineers. The union which so many Revolutionary War Engineers had supported was short-lived. Yet the Corps of Engineers survived the peacetime reduction and took charge of the military academy now established permanently at West Point.

1780 plan for West Point.

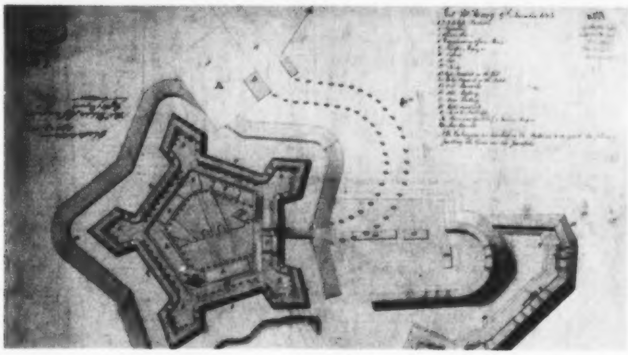
Historical Division, Corps of Engineers



The Siege & Defence
FORT ERIE

Engineers in the War of 1812

Plan of Fort McHenry.



National Archives

Library of Congress

Lundy's Lane.

After the Revolution, engineer officers did not see combat again until the War of 1812. In that war their record was exceptional in comparison to the record of the other branches of the Army. When the war broke out in June, the Corps of Engineers' actual strength was only 17 officers and 19 enlisted men. Although Congress had authorized the Corps 22 officers and 113 enlisted men in April 1812, full strength was not approached until 1815. West Point graduates dominated the list of officers serving in the Corps and for all it was their first experience in combat.

During the years immediately preceding the conflict engineer officers had worked full-time constructing permanent defenses along the Atlantic coast. As the war progressed, the War Department increasingly transferred engineers to serve in the field on the Northern frontier. In combat the engineers performed many of the same tasks they had in the Revolution—constructing fortifications, reconnaissance and mapping and assisting the movement of armies. In at least two instances engineer officers directed construction of quarters. Still, fortifications were the primary concern of the engineers during the War of 1812 as they had been earlier. Despite the views of later critics, coastal harbors heavily fortified by the engineers did deter British attack. Notable examples of this were at Fort Meigs and Fort McHenry in Baltimore.

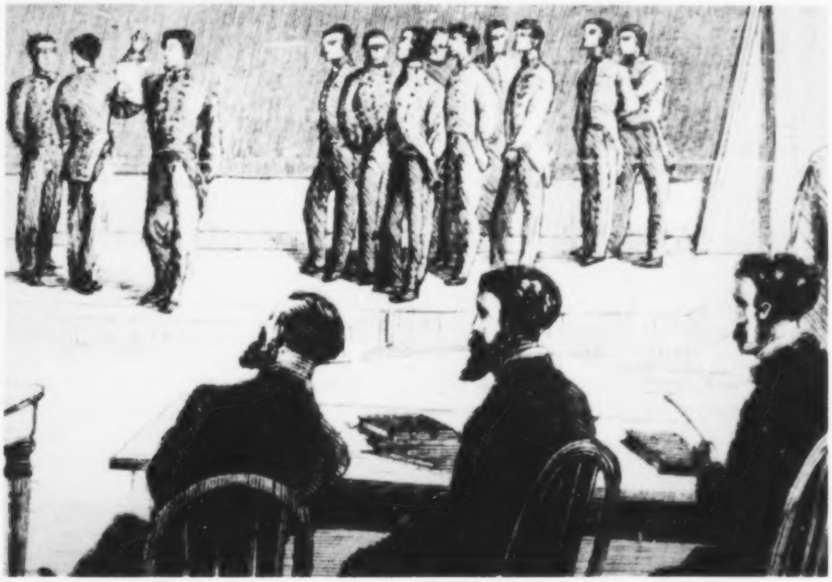
The War Department had debated with the engineers over their desire for command responsibility since 1802. Jonathan Williams, the first superintendent of West Point, had even resigned his position over the issue. During the War of 1812 engineer officers assumed command responsibility for the first time. Captain Charles Gratiot, later Chief Engineer, at one point commanded all forces in Michigan Territory. In 1813 Joseph G. Swift, another future Chief Engineer, commanded line units on Staten Island in addition to Fort Richmond and Hudson Battery. By late the next year he commanded the entire New York operation, which included more than 10,000 soldiers and civilian volunteers.

The performance of the Army engineers in combat between 1812 and 1815 helped them earn respectability and strengthened the military academy at West Point, which had been languishing on the eve of the war. While many battles in this indecisive war ended in a stand-off, the results might have been far worse without the contributions of the Army engineers.

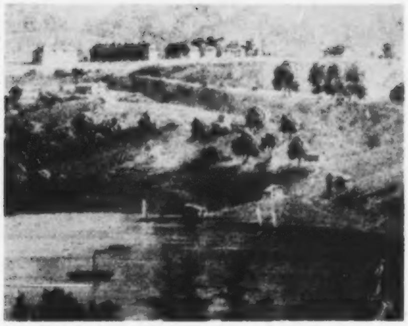
National Archives

1814 chart.

The Corps and the Military Academy at West Point, 1802-1866


Early West Point class.

Public Affairs Office, Corps of Engineers


Early view of West Point.

Public Affairs Office, Corps of Engineers

Portrayal of West Point student at work.

Public Affairs Office, Corps of Engineers

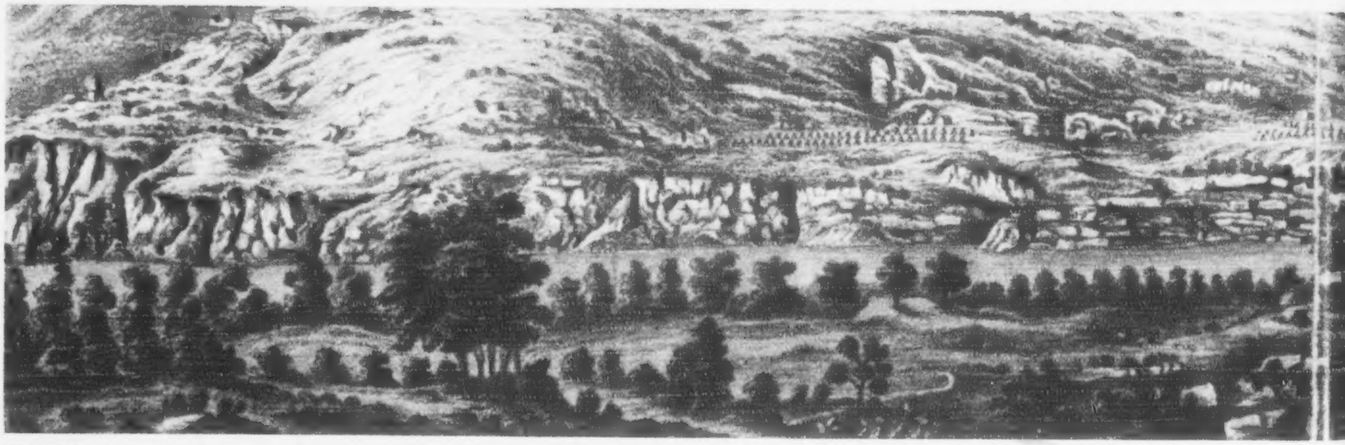
During the American Revolution many officers, including General George Washington, the commander in chief, saw the need for technical education so that the Army would have skilled, native American engineer officers in the future. When Congress established the companies of Sappers and Miners in 1778, it stated that the companies were to receive instruction in field works. In subsequent general orders Washington referred to the Sappers and Miners as "a school of engineering." Regulations issued in 1779 for the Corps of Engineers and companies of Sappers and Miners declared that the Sappers and Miners were to receive instruction at times when they were not exercising duties. The chief engineer was to devise an instructional program and appoint engineer officers to give lectures. The amount of education actually given the Sappers and Miners during the Revolution was minimal.

During the debate over a peacetime military establishment in 1783, several Army officers proposed establishing an academy at West Point either as the sole military academy or as one of several academies. Engineers particularly were thought to need formal training. When Congress decided against a peacetime standing Army, the need for an academy disappeared.

Some instruction did occur at West Point from 1794 until 1796, but it was not until May 16, 1802, that Congress reestablished a separate Corps of Engineers and constituted the Corps as the Military Academy. As Chief Engineer, Jonathan Williams, grand-nephew of Benjamin Franklin and a man keenly interested in the development of science, became the Academy's first superintendent. Williams introduced

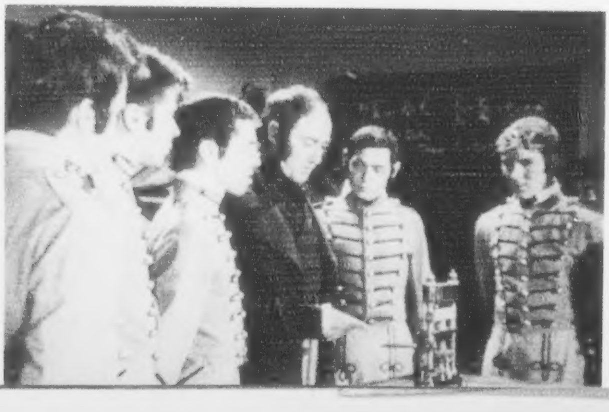
U.S. Military Academy class of 1904 cadets working with models.

U.S. Military Academy Library



West Point, from a L'Enfant watercolor.

Reenactment of West Point classroom instruction.



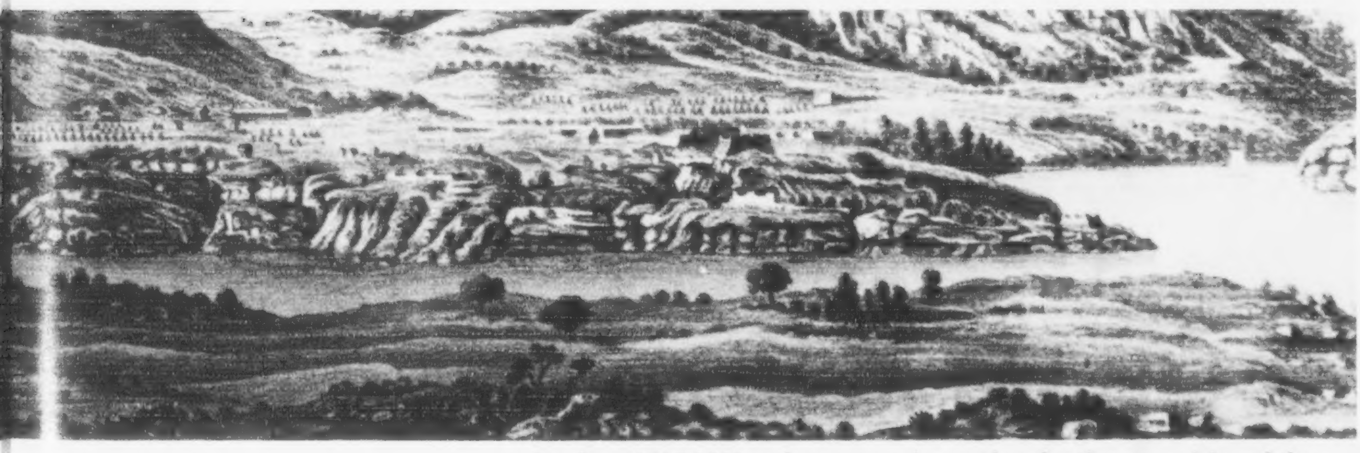
Public Affairs Office, Corps of Engineers

Dennis H. Mahan.

Historical Division, Corps of Engineers

new texts from England and the continent and by 1808 had broadened the curriculum from its heavy emphasis on mathematics to include engineering. In 1812 Congress created a professorship of engineering at the Academy. It was the first such position at an institution of higher learning in the United States.

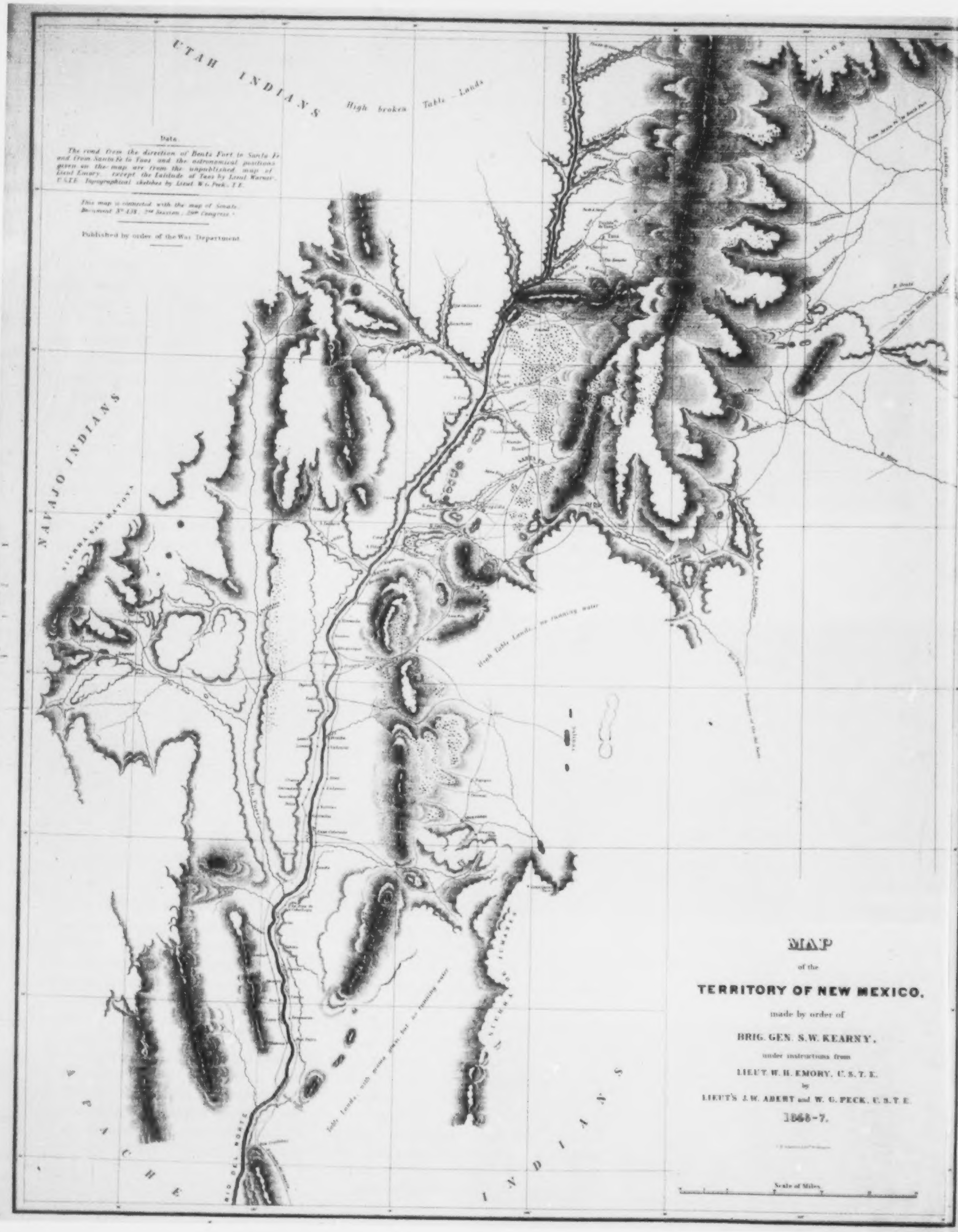
Major advances in the organization and the course of study, as well as an honor code and a disciplinary system, followed under Sylvanus Thayer, superintendent from 1817 until 1833. Thayer patterned the reorganization of the Academy on the program he observed at the Ecole Polytechnique while on a visit to France. Claudius Crozet, who occupied the professorship of engineering from 1817-1823 and was a graduate of the Ecole Polytechnique, introduced numerous French texts in his courses. Later, under Dennis Hart Mahan, the Academy's reputation as a school of civil engineering advanced still further. In his lectures Mahan, an 1824 graduate with a commission in the Corps of Engineers, drew upon his experiences while on duty in Europe (1826-1830). He prepared and added several texts to the West Point curriculum. The most important were *A Treatise on Field Fortification* (1836) and the *Course of Civil Engineering*, which first appeared in 1837.



National Archives

In 1800 Secretary of War James McHenry had emphasized that fortification was only one part of the engineering profession. The engineer's utility, he declared, "extends to almost every Department of War; besides embracing whatever respects public buildings, roads, bridges, canals and all such works of a civil nature." After the War of 1812 West Point exemplified McHenry's dictum. The Academy was the first school of engineering in America and for many years produced graduates who played a major role in the internal improvement of the nation.

The Military Academy continued under the supervision of the Corps of Engineers until 1866, when Congress opened the superintendency to all branches of the Army and placed control of the Academy under the secretary of war, thus ending the Chief of Engineers' role as Inspector. This change responded in part to the fact that the Academy supported the entire Army, not just the engineers. Mathematics, science and engineering remained at the center of the curriculum.


UTAH INDIANS
High broken Table - Lands
NAVAJO INDIANS
RATON
High Table Lands, no running water
Table Lands, with grama grass, but no running water
SIERRA DE JUMANES
APACHE INDIANS
RIO DEL NORTE
Rio Puerco
Scale of Miles

Data.

The road from the direction of Bents Fort to Santa Fe and from Santa Fe to Taos and the astronomical positions given on the map are from the unpublished map of Lieut Emory, except the Latitude of Taos by Lieut Warner, U.S.T.E. Topographical sketches by Lieut W. G. Peck, T.E.

This map is connected with the map of Senate Document No. 438, 2nd Session, 29th Congress.

Published by order of the War Department

MAP

of the

TERRITORY OF NEW MEXICO.

made by order of

BRIG. GEN. S.W. KEARNY,

under instructions from

LIEUT. W. H. EMORY, U.S.T.E.

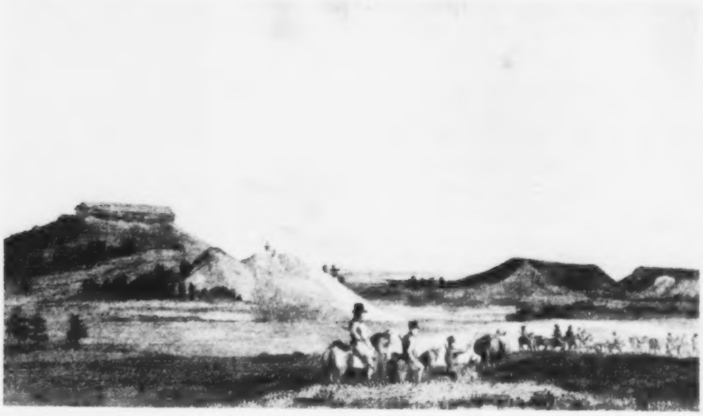
by

LIEUT'S J.W. ABERT and W. G. PECK, U.S.T.E.

1846-7.

Explorations and Surveys

View of the insulated table lands at the foot of the Rocky Mountains.



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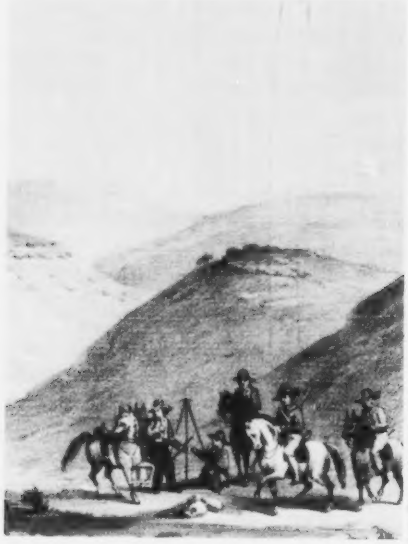


Historical Division, Corps of Engineers

Survey party at work

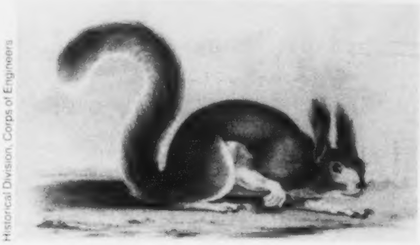
Although the reconnaissance of the trans-Mississippi West began with the epic journey of Lewis and Clark in 1804-1806, another 10 years passed before the government began to establish the basis for the professionalization of official exploration. In 1816 topographical officers, known as geographers during the Revolution and as topographical engineers during the War of 1812 and thereafter, were added to the peacetime Army. Unlike the other officers of the Corps of Engineers, whose primarily military duties centered on the construction and maintenance of fortifications, "topogs" performed essentially civil tasks as surveyors, explorers and cartographers. Two years later the War Department established the Topographical Bureau under Major Isaac Roberdeau to collect and store the maps and reports of topographical operations. Like the topogs, who numbered only six at this early date, the bureau was placed under the Engineer Department.

Almost from the outset there was a great demand for the skills of the topographical engineers. The accelerated movement of Americans into the interior of the continent served to emphasize the nation's need for networks of transportation and communication. Congress recognized the compelling nature of the requirement in 1824 by passage of the General Survey Act. This law, which authorized surveys for a national network of internal improvements, became the basis for topog involvement in the development of canals, roads and later, railroads.

Along with the growing importance of the topogs came increases in their numbers and improvements in the organizational structure. Most of the changes came during the first decade of Colonel John J. Abert's tenure as Chief of the Topographical Bureau. A strong-willed and ambitious West Pointer who received the appointment after Roberdeau died in 1829, Abert sought independence for both the bureau and the topogs. He realized the first goal in 1831, when Congress removed the bureau from the Engineer Department and gave it departmental status under the secretary of war. Seven years later he attained the second objective and became Chief of an independent Corps of Topographical Engineers, a position he held for 23 years.

Colonel Abert sought a great deal more for the topogs than prominence within the bureaucracy. While Roberdeau had been content to manage the office as a depot for maps and instruments and as a

Map of the Rio Grande Valley, drawn in 1846-47 for Mexican War reconnaissance.

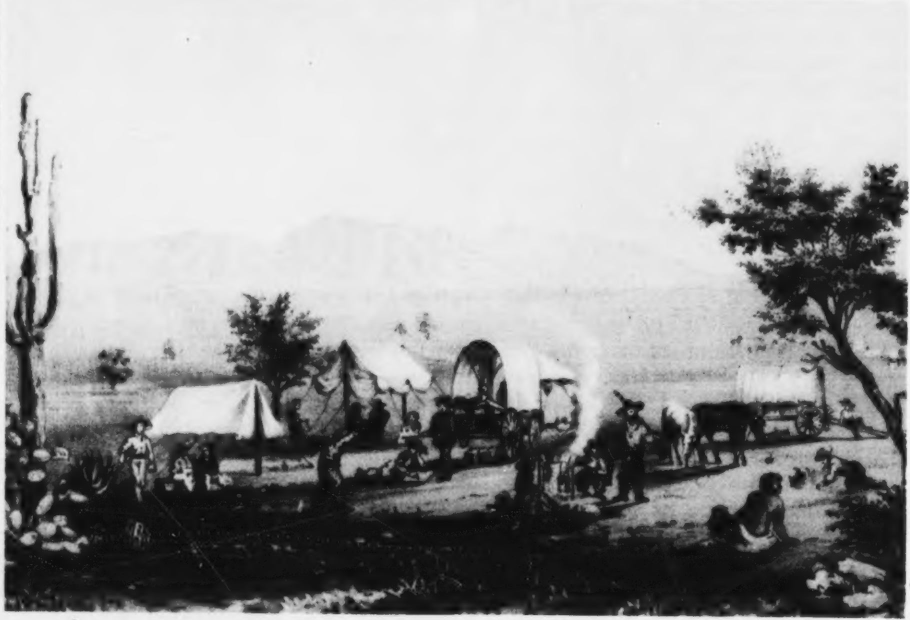


Historical Division, Corps of Engineers

Sciurus Aberti, squirrel named for John J. Abert, drawn by Richard H. Kern.

clearinghouse for correspondence, Abert saw his role as a planner and administrator for national policy regarding internal improvements and western exploration. As a member of the Board of Engineers for Internal Improvements, established to evaluate projects considered under the General Survey Act, Abert had a part in the selection of tasks and their execution. In western exploration, which for many years took a back seat to internal improvements, Abert's role remained minor. His bureau distributed instruments, collected maps and forwarded correspondence.

Individual members of the Corps of Topographical Engineers, however, achieved great importance in western exploration and surveys. During the expansionist era of the 1840s, from the first stirrings of Oregon fever in the early years of the decade to the acquisition of the huge southwestern domain after the Mexican War, topogs examined the new country and reported their findings to a populace eager for information about the lands, native peoples and resources of the West. Best known of all was John C. Frémont, the dark-eyed and flamboyant Pathfinder who led three parties to the Rockies and beyond during this age of expansion. The ranks also included William H. Emory, author of a perceptive assessment of the Southwest, and James H. Simpson, discoverer of the ruins of the ancient Pueblo civilization of New Mexico. Howard Stansbury, whose report of an exploration of the Great Salt Lake is still considered a frontier classic, also wore the gold braid of the Corps of Topographical Engineers. In the 1850s, when the emphasis shifted from reconnaissance to more detailed exploration and roadbuilding, topogs continued to make their marks. John N. Macomb laid out the basic road net work of New Mexico and George H. Derby initiated harbor improvements in California, while Joseph C. Ives became the first Anglo-American to descend the Grand Canyon.



Historical Division, Corps of Engineers

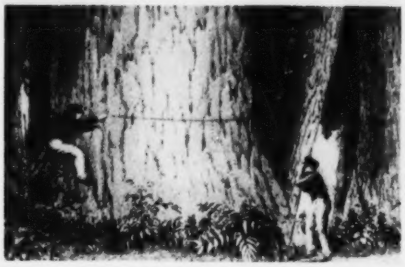
Pacific railroad survey party camped in the Mohave Valley.

The disparity between the renown of members of Abert's Corps and the obscurity of his bureau was due to the absence of a government policy regarding exploration. Topographical engineers frequently went into the new country on an *ad hoc* basis, at the behest of a politically powerful figure like Missouri Senator Thomas Hart Benton, or to accompany a military expedition. From Major Stephen H. Long's 1819 journey up the Missouri River as a minor adjunct of Colonel Henry Atkinson's Yellowstone Expedition to Emory's Southwestern Exploration with the Army of the West during the Mexican War, topog exploration often took a secondary position to other purposes.

When exploration and surveys in the trans-Mississippi West were finally organized and coordinated in the 1850s, Abert no longer wielded the political influence that had brought his ambitions so near fruition in the 1830s. Duties he hoped would devolve on the Topographical Bureau went instead to the Office of Pacific Railroad Explorations and Surveys. This small organization, created by Abert's political foe, Secretary of War Jefferson Davis, managed the surveys for railroad routes to the Pacific Ocean. Of the leaders of the survey parties, only former engineer Isaac I. Stevens was not a topog. The railroad surveys produced a multi-volume report that was a veritable encyclopedia of trans-Mississippi natural history as well as reconnaissances of future railroad routes to the Pacific.

Despite the lack of a unified policy and central direction, the history of topog expeditions forms a coherent entity. Topographical officers provided the necessary link between the first explorations of the mountainmen—those rude, brawling

Oregon pine forest, 1844.



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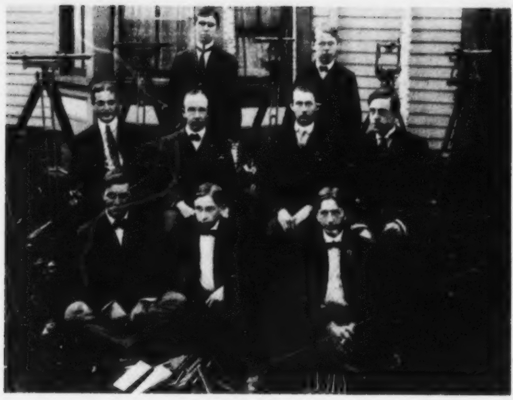


Public Affairs Office, Corps of Engineers

Survey party at Thompsonville, Connecticut, 1903.

beaver trappers who first probed far beyond the frontier and were no less than walking storehouses of geographical knowledge—and the civilian scientific specialists who undertook a rigorous study of western natural history and resources after the Civil War. Between the trappers and the specialists of the United States Geological Service, topogs provided the nation with an overall picture of the trans-Mississippi region. They explored bits and pieces as opportunity allowed until a coherent general understanding of western topography emerged in the form of Lieutenant Gouverneur K. Warren's map of 1857. His achievement, the first accurate overall depiction of the trans-Mississippi West, was a milestone in American cartography. Thereafter, topog activity centered on filling in the few blank spaces in Warren's map. During the Civil War, the Corps of Topographical Engineers was merged into the Corps of Engineers, whose officers renewed the topogs' efforts after Appomattox. Within a few years, however, civilian scientists took over the work and carried it forward. By then the officer-explorers had done their major task. They had extended and codified the knowledge of the mountainmen and in turn laid the groundwork for scholarly analysis. The topographical engineers had performed an essential service to a nation growing in size and in self-understanding.

Engineer Observations of the *Aurora Borealis*

While exploring and surveying the American West in the 19th century, Army engineers and topographers amassed a wealth of scientific information. Their concerns included archeology, astronomy, botany, biology and meteorology. Little known are a series of astronomical observations made by engineer officers undergoing training at the Engineer School of Application at Willets Point, New York, in the 1870s and 1880s.

The engineers made the bulk of their studies from an observatory constructed on the post in 1868. A new observatory boasting telescopes, transits, chronometers and chronographs opened in September 1879. The officers calculated longitude and latitude utilizing the sun, moon, stars and planets. In the course of their training exercises, which supplemented classroom work, the students had the opportunity to observe and record unusual phenomena. Such was the case in a series of systematic field observations of the *aurora borealis* begun in February 1870 and continued through 1884.

The engineers made the auroral observations purposely in an effort to determine the relationship between auroral displays and the frequency of sunspots and magnetic disturbances. Sentinels from the engineer battalion on duty from sunset to sunrise at three guard posts recorded all visual sightings, noting whether skies were clear or cloudy. To account for human error, especially for the difficulty of identifying fainter displays, the battalion compiled tables noting the three independent observations, calculating a mean average and estimating the number of displays that might have occurred on cloudy nights. Officers stationed at the engineer supply depots at Washington Barracks, Missouri, and at Yerba Buena Island in San Francisco Bay also made their own less detailed observations, which in turn were compared with those at Willets Point.

While records of sunspot activity were not kept systematically, the battalion commander concluded from data available that the years of maximum and minimum sunspot activity corresponded with maximum and minimum auroral displays. The auroral statistics gathered at Willets Point are the earliest available and today continue to be useful to scientists studying the recurrence of the *aurora* and its relationship to sunspot activity.

The National Road

Looking east toward Cumberland, Maryland.

National Archives

Through Clarysville, Maryland.

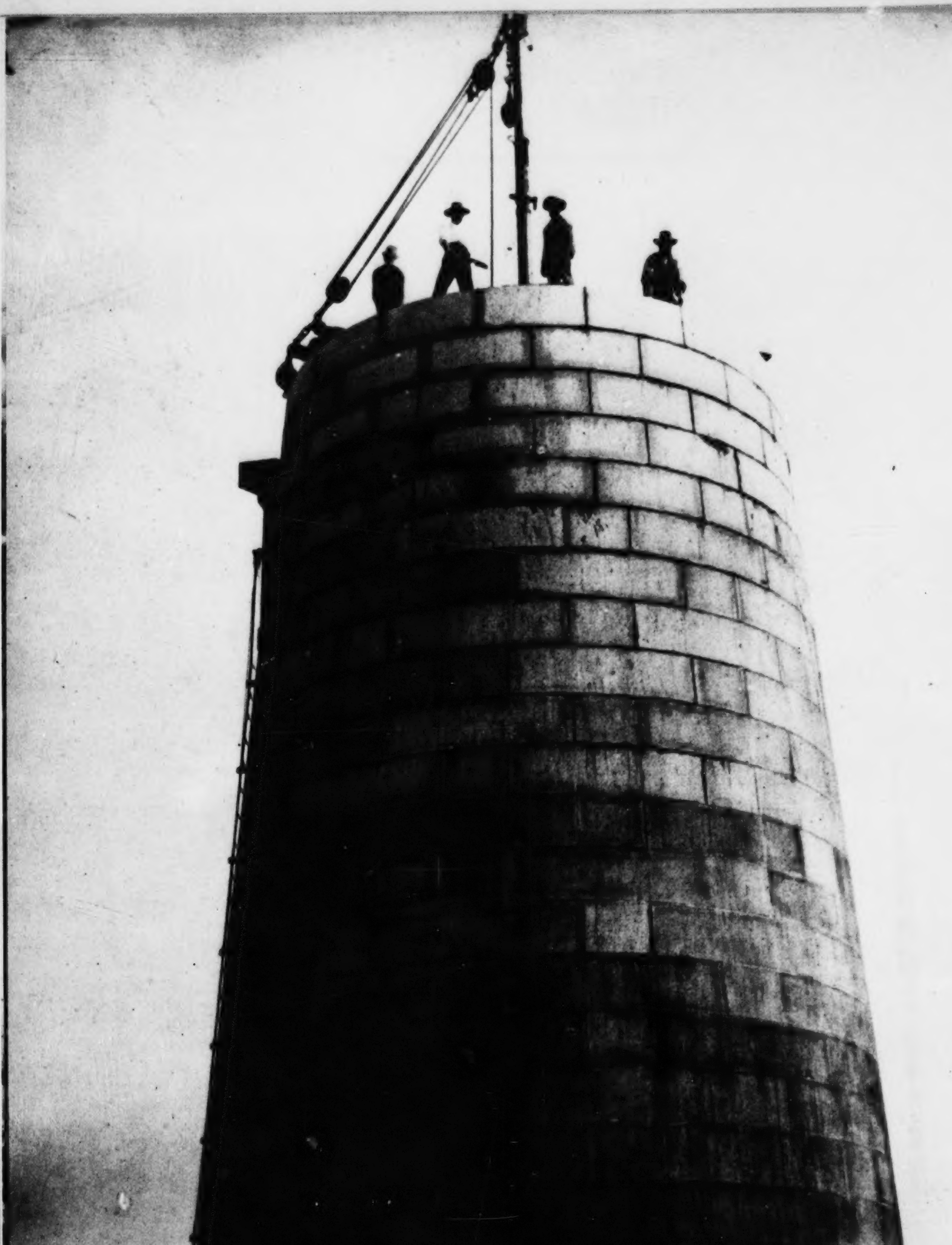
National Archives

As pioneers and immigrants went westward, trade flourished and the need for a highway linking the Atlantic seaboard with the Ohio and Mississippi rivers became apparent. In 1811 Congress authorized the Department of the Treasury to let contracts for the construction of a road from Cumberland, Maryland, to Wheeling, West Virginia. This stretch, which became known as the Cumberland Road, was completed in 1818. Seven years later the Corps of Engineers became involved in construction and repair operations. Engineer officers, most notably Lieutenant Joseph K. F. Mansfield and Captain Richard Delafield, supervised the repair of the Cumberland Road while other engineers concentrated on extending the road into Ohio, Indiana and Illinois. In this way, the highway became a true national road.

The men assigned to the Cumberland Road learned a valuable lesson in road maintenance. The original construction failed to allow sufficient drainage, since the roadbed was lower than the surface of the ground on both sides. Accumulated water and ice caused the road to deteriorate to the point of impassibility. Chief Engineer Charles Gratiot directed his officers to repair the road according to the Macadam Plan—the latest European technology. The original surface was entirely broken up and raked smooth, with a rise of no more than three inches at the center. Drainage ditches were then dug so that water could stand no less than 18 inches below the lowest part of the road surface. After the culverts were cleaned, a final layer of crushed limestone, flint or granite, from three to nine inches thick, was added.

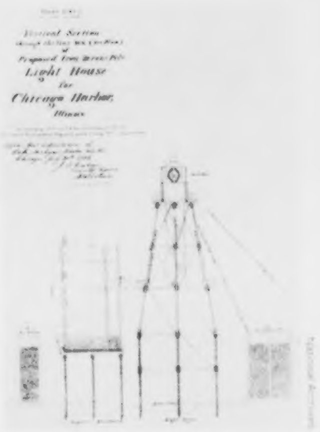
A notable feature of the Cumberland Road was its sturdy bridges, many of them stone arches allowing pioneer wagons to cross major streams. At Dunlap's Creek in Brownsville, Pennsylvania, Army engineers replaced a ruined chain bridge with a cast iron structure—the first iron bridge in America. Captain Delafield, later to become Chief of Engineers, prepared his own design, without regard to the principles of iron bridge construction developed by English and French engineers in the 1770s. Iron proved to be the most practical material at Brownsville because iron foundries were located there. The bridge, with its abutment and wingwalls of sandstone and cast iron ribs and spandrels, spanned 80 feet. Completed in 1832, it remained in use for decades, offering passage first to stage coaches and then to motor trucks before it was replaced by a larger steel and concrete structure.

Traveling on the National Road, 1939.



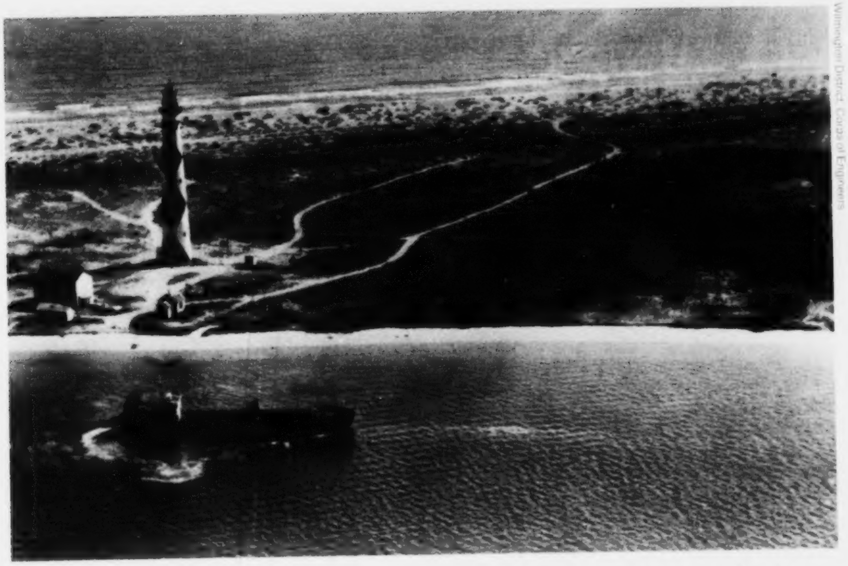
Wednesday, August 3, 1859.

Lighthouses



National Archives

Proposed iron screw-pile lighthouse for Chicago Harbor.



Wilmington District, Corps of Engineers

Cape Lookout Lighthouse, North Carolina.

As early as 1716 on the Atlantic Coast, private parties built lighthouses. Army engineers began supervising lighthouse construction in 1831 when the Treasury Department placed funds appropriated for these improvements in the hands of the Chief Engineer. A federal Lighthouse Board, created in 1852, assumed the responsibility for supervising lighthouse construction and inspection. Three engineer officers were members of the original Lighthouse Board and one was assigned as inspector of the lighthouse districts.

In the 19th century, engineer officers designed lighthouses to help mariners weather violent Atlantic storms. Adopting European technology, those officers often innovated to solve particular problems. Major Hartman Bache borrowed from the British engineers the design for the first screw-pile lighthouse in the United States. This type of pile was ideal for the bottom of the Delaware Bay, since it could be securely twisted into an unstable sea floor. To fend off the floating ice that threatened a structure at Brandywine Shoal, Delaware, Bache installed a fence, consisting of screw-piles, five inches in diameter, around the lighthouse. He then added an outer fence and the space between the two fences was platformed over. Tons of stone riprap were dumped around the structure to provide additional protection. Engineering advances later made it possible to erect sturdy lighthouses on the reefs around the Florida Keys, the most famous of these being the Sombrero Key lighthouse, built by Lieutenant George Meade seven years before he met General Robert E. Lee at Gettysburg in July 1863.

Building Minot's Ledge lighthouse off Cohasset, Massachusetts, August 3, 1859.

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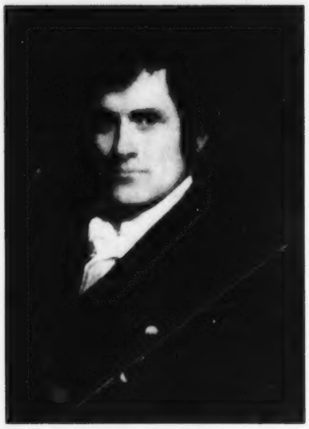
U.S. SNAG

Origins of Civil Works Missions

Public Affairs Office, Corps of Engineers

Engineers aid in railroad construction, c.1880



Army Art Collection

John C. Calhoun, by John Wesley Jarvis.

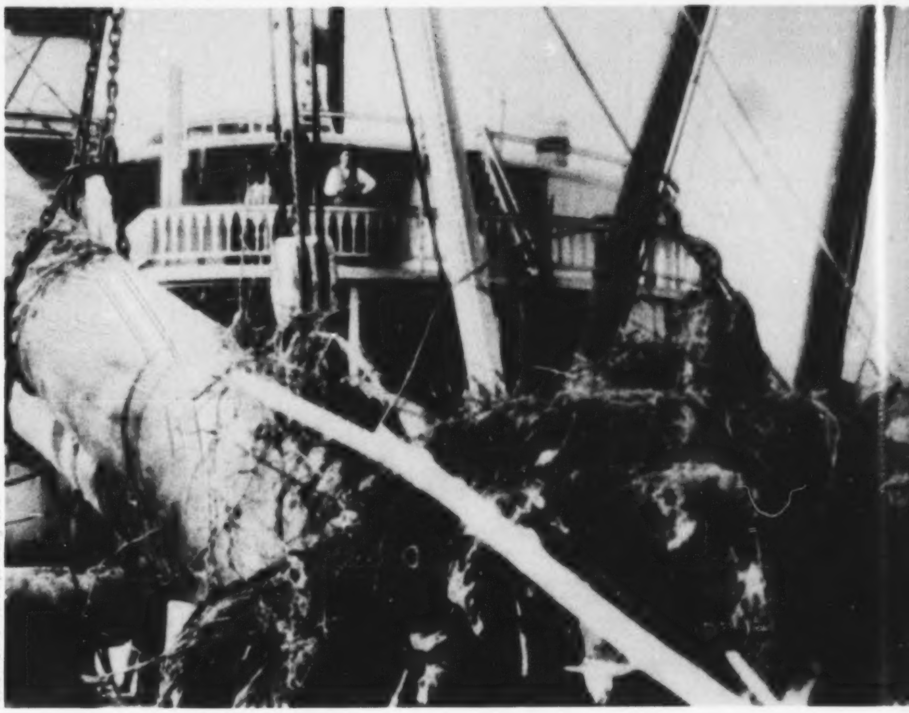
One of the major lessons of the War of 1812 was that the nation needed an improved defense and transportation system. The British had invaded the country from the north, from the south at New Orleans, and from the east, marching inland and even putting the capital to the torch. In the 1816 mobilization studies based upon the lessons of the War of 1812, the Corps of Engineers reported that national defense should rest upon four pillars: a strong Navy at sea; a highly mobile regular Army supported by reserves and National Guard; invincible defenses on the seacoasts; and improved rivers, harbors and transportation systems that would permit rapid armed concentration against an invading enemy and swifter, more economical logistical lines.

In 1819 John C. Calhoun, then secretary of war, recommended that the Corps of Engineers be directed to improve waterways navigation and other transportation systems because such civil works projects would facilitate the movement of the Army and its materials while contributing to national economic development. "It is in a state of war when a nation is compelled to put all of its resources . . . into requisition," said Calhoun, "that its Government realizes in its security the beneficial effects from a people made prosperous by a wise direction of its resources in peacetime."

Congress finally accepted Calhoun's recommendations in 1824.

U.S. Snagboat No. 2, similar to those constructed in the 1840s and 1850s, from *Harper's Weekly*, November 2, 1889.

Snagboat clearing debris.



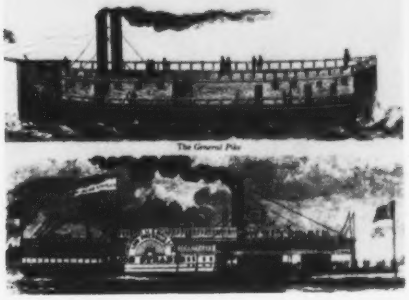
Public Affairs Office, Corps of Engineers

U.S. Steamer *Aid* battles raft no. 5 on the Red River.

U.S. Military Academy Library

Public Affairs Office, Corps of Engineers

U.S. Dredge *Harwood* at Milton's Bluff, Muscle Shoals, Alabama, May 1889.



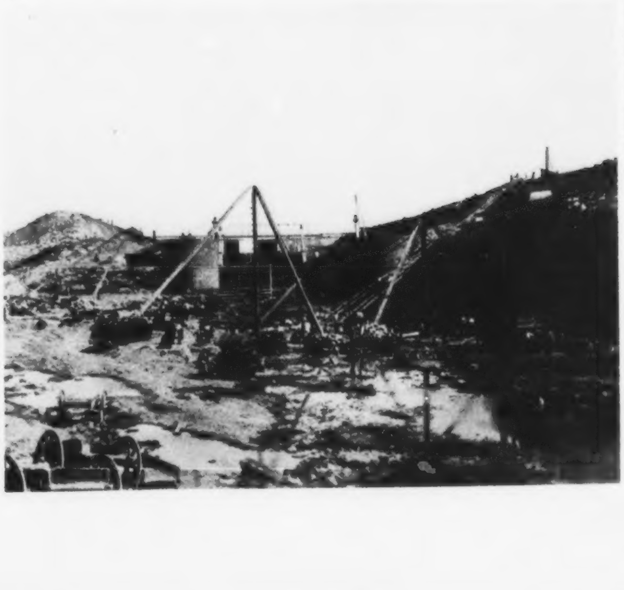
Up the Heights of Fame and Fortune by Frederick B. Read, 1873

Early steamers on the Ohio, c.1820.

It passed a General Survey Act on April 30 that authorized the President to use Army engineers to survey road and canal routes "of national importance, in a commercial or military point of view." A few weeks later, on May 24, Congress appropriated $75,000 for improving navigation on the Ohio and Mississippi rivers. This law allowed the President to employ "any of the engineers in the public service which he may deem proper" for the work.

Under the May 24 act, the Corps began to remove snags and floating trees from the Ohio and Mississippi rivers and to improve the Ohio's channel by attacking the sandbars that impeded river commerce. By 1829 Army engineers were using snagboats developed by the famous steamboat captain Henry M. Shreve to remove obstructions in river channels. This early activity marked the beginning of the Corps' civil works mission—a dual role that emphasized a practical blending of civil works and military skills and fostered the development of a federal agency prepared to shoulder the engineering burden in the event of war or national emergency.

Louisville and Portland Canal under construction, 1871.



Public Affairs Office, Corps of Engineers

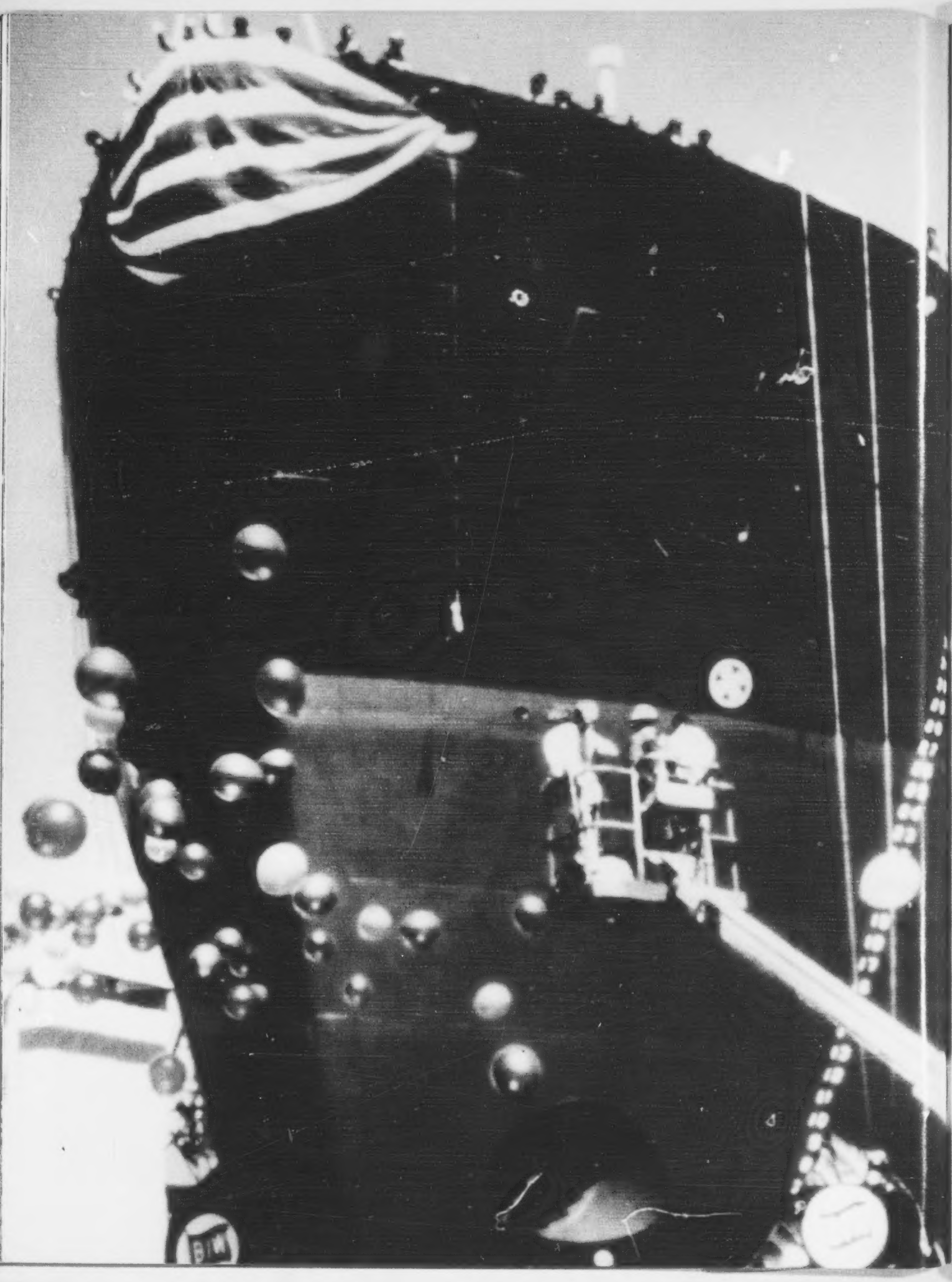
"A Globe of Compression": Brigadier General Joseph G. Swift and the New York Fire of 1835

Long before the Corps as an organization was charged with aiding victims of natural disasters, Army engineers as individuals lent a helping hand to fellow citizens in time of trouble. An early example of the engineer as good samaritan was provided by Brigadier General Joseph G. Swift, former Chief Engineer, during the great New York fire of 1835.

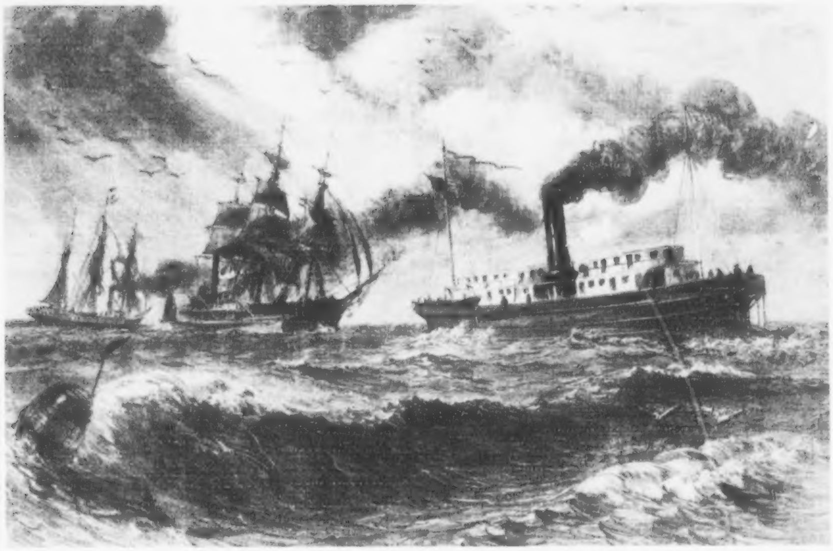
Fire broke out in lower Manhattan on December 16 of that year. It spread rapidly, consuming houses and stores. The blaze threatened to devour the entire city.

Alarmed and desperate, the New York City mayor turned to General Swift, a municipal hero since 1814, when he directed the city's defense against threatened British attack. At the time of the fire, Swift was retired from the Army and working as a civilian on harbor improvements for the Corps. Swift decided to contain the blaze behind a line of purposely demolished buildings. He calculated how much gun powder would be needed to "shake down" a house without damaging neighboring properties. Then he directed the placing of the charges in such a way to create "a globe of compression" when ignited. As the powder went off, walls toppled inward and houses collapsed in ruins upon themselves, leaving adjacent structures unharmed. A novelty at the time, this technique is now common practice in the urban demolition business.

At great personal risk, Swift set off charge after charge, arresting the fire's advance on December 17 and thus saving countless lives and millions of dollars in property. For the second time in two decades, he received the city's official thanks.



Waterway Development



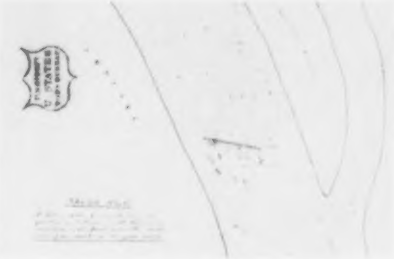
Corps of Engineers Dredge *Essayons* at the mouth of the Mississippi c.1870

Excavating the Illinois and Mississippi Canal, 1904

Benjamin Henry Latrobe, a famous early 19th century engineer, once remarked that "nothing is so easily converted to a civil use, as the science common both to the profession of a civil and military engineer." Few of Latrobe's contemporaries questioned this observation; engineers were also scientists and navigation improvements required a scientific approach utilizing principles developed mainly in Europe. At West Point, Army engineers learned the principles and applied them in their surveys of navigable rivers, often making their own significant contributions to river hydraulics in the process. In the early 1820s, Corps of Engineers officers surveyed both the Ohio and lower Mississippi rivers. In the succeeding years many more rivers were investigated. Many early navigation improvements resulted from trial and error, however, rather than from strict adherence to theory. If the obvious did not work, the less obvious was used, until some method seemed to produce the desired result. A good example is the work on the Ohio River.

In 1824 Chief Engineer Alexander Macomb dispatched Major Stephen H. Long to the Ohio to initiate experiments to provide safer navigation. The major challenge was to deepen channels across sand and gravel bars. Long decided to perform experiments on a compacted gravel bar near Henderson, Kentucky, just below the mouth of

The *Essayons*, 1984



Sketch showing position of dam and sandbar on the Ohio, 1825.

Brigadier General Godfrey Weitzel

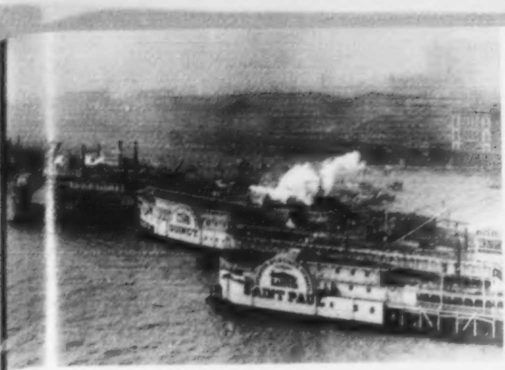
the Green River. At low river stage, this bar was covered by only 15 inches of water. After preliminary studies, the major outfitted several flatboats with hand-powered pile drivers and began to build a wing dam, so-called because the structure extended from the bank of the river at a 45 degree angle. The dams decreased the width of the channel, thereby increasing the current's velocity. Theoretically, this would cause the river to scour a deeper channel. Long built the dam to various widths, lengths and heights. The final structure was 402 yards long and consisted of twin rows of 1,400 piles joined with stringers and filled with brush. Sediment gathered against the dam and helped anchor it to the riverbed. The project's total cost was $3,378.93.

Dipper dredge at work.

Wing dams such as Long's were used on the Ohio and other major rivers during most of the 19th century, but their effectiveness was always marginal. They were easily destroyed and did not always produce the desired results. After the Civil War, Corps officers grew increasingly skeptical about the dams. Brevet Major General Gouverneur K. Warren, a well-respected engineer officer, candidly wrote in 1867, "I do not believe the country will ever stand such a heavy continuous outlay as the wing-dam system of the Ohio has caused, and I believe that the extravagant and useless expenditure there, in the palmy days of western river improvements between 1830 and 1844, did more than anything else to bring the whole subject into disrepute."

Warren's pessimism was unjustified, for both Congress and commercial interests continued to support waterway improvements after the Civil War. Indeed, the support increased. Rivers and harbors work jumped from about $3.5 million for 49 projects and 26 surveys in 1866 to nearly $19 million for 371 projects and 135 surveys in 1882. Nevertheless, Warren's frustration was shared by other engineers. W. Milnor Roberts, a well-known civil engineer, concluded in 1870 that existing navigation facilities on the Ohio, while certainly of public benefit, were no better than an "amelioration of the present difficulty." He proposed instead to canalize the river through the construction of 66 locks and dams. This project would offer six-foot slackwater navigation from Pittsburgh, Pennsylvania, to Cairo, Illinois.

Chief of Engineers Andrew A. Humphreys organized an Army Engineer Board of Inquiry, composed of Majors William E. Merrill and Godfrey Weitzel, to examine the question of canalizing the Ohio. The



Steamboats line the St. Louis waterfront, 1909.

officers agreed with Roberts that a system of locks and dams would best provide for future navigation. Somewhat surprisingly, the recommendation met resistance from the very group which would most profit from its implementation. Coal shippers, in Merrill's words, were "absolutely opposed to a slack-water system, unless arrangements can be made to pass their fleets through without stopping and separating for the passage of locks."

The resistance forced Merrill, who was in charge of Ohio River improvements, to look for alternative solutions. He thought the wicket dam design developed by Jacques Chanoine in France in 1852 might be adapted for use on the Ohio. The structure utilized a number of large folding boards, called wickets, which were hinged to a concrete base at the bottom of the river. Each wicket was about 3-3/4 feet wide and 12 feet long. When the wickets were raised, the water behind them rose high enough to insure navigation. During high water they could be lowered to allow boats to pass unimpeded. In this way, the delays the coal shippers feared would be avoided.

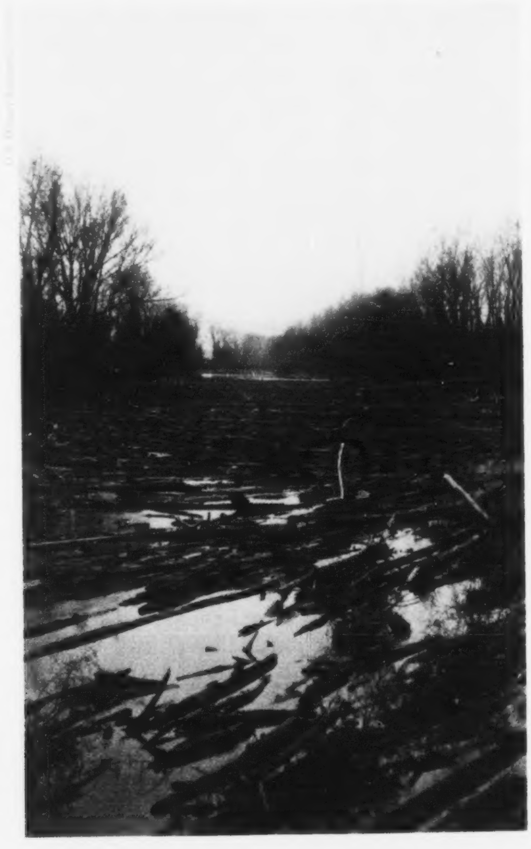
In 1874 Merrill proposed that a series of movable dams, employing Chanoine wickets, be constructed on the Ohio. For the first step, he recommended that a 110 by 600-foot lock and movable dam be built at Davis Island, five miles below Pittsburgh. In 1877 Congress approved Merrill's plan. A year later, the

Lt. Eugene A. Woodruff: "A Model for all Similar Undertakings . . ."

In 1873 Captain Charles W. Howell, district engineer at New Orleans, assigned his deputy Lieutenant Eugene A. Woodruff to the Red River of Louisiana as supervisor of the project to clear the river of the great log raft, a formidable obstruction to navigation. In September of that year, Lieutenant Woodruff left his workboats and crew on the Red River to visit Shreveport and recruit a survey party. When he arrived, he found Shreveport in the grip of a yellow fever epidemic. Fearing that he might carry the disease to his workmen if he returned to camp, Woodruff elected to remain in Shreveport and tend to the sick. Volunteering his services to the Howard Association, a Louisiana disaster relief charity, he traveled from house to house in his carriage, delivering food, medicine, and good cheer to the sick and dying. He contracted the disease and died of it in Shreveport on September 30.

"He died because too brave to abandon his post even in the face of a fearful pestilence and too humane to let his fellow beings perish without giving all the aid in his power to save them. His name should be cherished not only by his many personal friends, but by the Army, as of one who lived purely, labored faithfully, and died in the path of duty. . . . His conduct of the great work on which he was engaged at the time of his death will be a model for all similar undertakings and the completion of the work a monument to his memory," wrote Captain Howell.

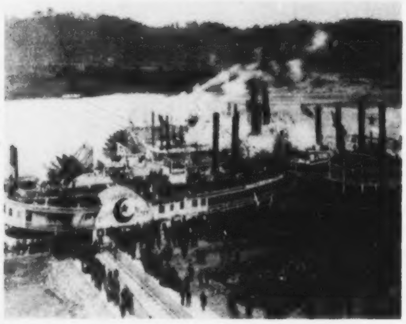
Howell then assigned the task of completing the work on the Red River to Assistant Engineer George Woodruff, the lieutenant's brother. On November 27, 1873, the Engineers broke through the raft, finally clearing the Red River for navigation.



Log raft on the Red River

Placing bank protection along the Arkansas River near Pine Bluff, 1881.

National Archives



The Davis Island Lock dedication, October 7, 1885.

Public Affairs Office, Corps of Engineers

Corps began construction of the Davis Island project, completing it seven years later. The 110 by 600-foot lock was the largest in the world, as was the 1,223-foot-long dam. The dam was actually composed of 305 separate Chanoine wickets and three weirs.

Impressed by the early success of the Davis Island project, in 1888 Congress authorized the extension of the six-foot navigation project down the Ohio. By 1904 two locks and dams had been completed, seven were under construction and five more were funded. At this time, before further work was done, Chief of Engineers Alexander Mackenzie decided to conduct another complete review of the project. The basic question was whether the project should be extended down the lower Ohio River, particularly in view of generally declining commerce on inland waterways.

Pursuant to congressional authorization, Mackenzie appointed a board headed by Colonel Daniel W. Lockwood and therefore called the Lockwood Board. Its review of the Ohio River project led to recommendations for a nine-foot project for the entire course of the Ohio. This conclusion rested on the finding that the probable cost per ton-mile for a six-foot project would be nearly fifty percent greater than for the nine-foot project. In the 1910 Rivers and Harbors Act, Congress authorized the construction of a nine-foot Ohio River canalization project. At a cost of about $125 million, the project was completed in 1929.

Meanwhile, the Corps had been busy in other parts of the country developing a reliable internal waterway system. One of the key projects, going back to the mid-19th century, was the Soo Locks at Sault St. Marie, Michigan. These locks were instrumental in securing a navigable route from the copper and iron mines on the shores of Lake Superior to the industrial plants of the East. In 1852 Congress agreed to help private interests finance the cost of building a canal at St. Marys Falls to replace a structure on the Canadian side that had been destroyed during the War of 1812. Congressional participation involved granting 750,000 acres of land to the state of Michigan. Captain August Canfield of the topographical engineers was assigned as chief engineer and superintendent of the project for the state of Michigan. Canfield's design for the canal conformed to the congressional stipulation that the passage should be not less than 100 feet in width and 12 feet deep, with two locks not less than 250 feet long and 60 feet wide.

Within two decades, burgeoning traffic and larger vessels made the original canal inadequate to serve commercial needs, so Congress authorized the deepening of the St. Marys River channel and the construction of a new facility—the Weitzel Lock. Corps work began on July 11, 1870, with the appropriation of $150,000. The original canal was widened, varying from 50 to 108 feet, the depth increased from 12 to 16 feet, and the Corps constructed a lock 515 feet long by 80 feet wide with a lift of 17 feet.

At the time of its construction, the Weitzel Lock was considered to be the latest in lock technology. Its culvert valves, of the butterfly type, were operated by a single stroke hydraulic engine directly connected to the valves. Hydraulic turbines generated the power which operated the lock gates. A movable dam was also introduced to shut off the flow of water during maintenance operations.

The Army's success in providing a passage to Lake Superior and Canada's commitment to canal building whetted the desires of shippers and industrialists for a deep water route through the Great Lakes—a dream eventually realized in the 20th century with the completion of the St. Lawrence Seaway.

It was the turn of the century when Congress responded to the renewed interest in water transportation by authorizing navigation projects designed to create an integrated system connecting inland areas with coastal harbors. Sandbars and rapids along the Ohio, Missouri, Arkansas and other major rivers posed major obstacles to the maintenance of year-round navigation channels. Eventually, with the advancement of lock and dam technology and more efficient dredging equipment, a nine-foot channel depth was assured in the Mississippi and its major tributaries.

Presently Corps of Engineers navigation projects continue to play an expanding role in support of America's economic well-being. Commercial use of the 25,000 miles of inland and intracoastal waterways has increased dramatically in recent years; approximately one-sixth of all intercity cargo is transported by water. Waterborne commerce, recognized by experts to be the least expensive and least energy-consumptive means of transportation, is the logical choice for shippers of energy-producing commodities. Petroleum and coal comprise together slightly more than 60 percent of all waterborne freight on the federally maintained waterways.

This expansion has been facilitated by the Corps' work on major waterways, including lock and dam

Public Affairs Office, Corps of Engineers

Mixing plant on the Illinois and Mississippi Canal, 1900

facilities. The Corps dredges more than 350 million cubic yards of material annually in order to maintain authorized channel depths and constructs bank stabilization projects in its traditional role as the primary developer of the nation's waterways. The engineer districts and divisions also operate a total of 258 locks, 220 main facilities and 170 dams for navigation purposes. An efficient system of interconnected waterways has proved to be a key factor in America's ability to mobilize in the event of war.

Historical Division, Corps of Engineers

Soo Locks

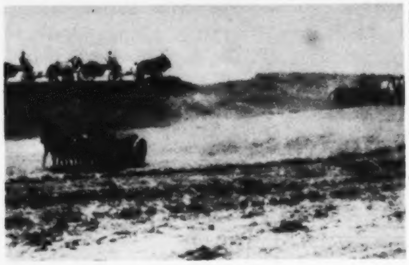
Engineer as Steamboat Designer

Colonel Stephen H. Long, an engineer officer famous for his exploration of the American West and for the survey and construction of early American railroads, also designed his own steamboat. In 1818, Long planned the building of the experimental craft, the *Western Engineer*, to transport himself and a task force of scientists, naturalists and artists as far west as possible by water on their projected trip into the frontier. The result was a steamboat designed to navigate narrow, shallow, snag-littered channels of inland rivers. It contained a particularly strong engine to provide increased power for pushing against swift currents. Another novel feature was a paddlewheel built into the stern to reduce the danger of damage from snags. The boat had a 75 by 13-foot hull with the weight of the machinery carefully distributed to permit increased maneuverability in shallow channels.

Altogether the *Western Engineer* was anything but a typical steamer. In fact, when launched in May 1819, its appearance was fearful—"Huge, black, scaly, the gigantic serpent blasted steam from its gaping mouth as it thrashed down the Ohio River, white foam dashing violently behind." In order to protect the vessel from Indian attack, Long installed a bulletproof pilot house. In addition, he had a cannon mounted on the bow, placed howitzers along the sides, and armed the crew with rifles and sabres. The boat had a serpent-like shape to frighten any would-be attackers.

The *Western Engineer*, drawing but 19 inches of water compared to the five or six feet of most steamboats, became the prototype of the western river steam vessels. In it, Long and his crew explored the Ohio River and ascended the Mississippi and Missouri rivers into Nebraska. On his journey, Long's *Western Engineer* traveled farther west than any other steamboat.

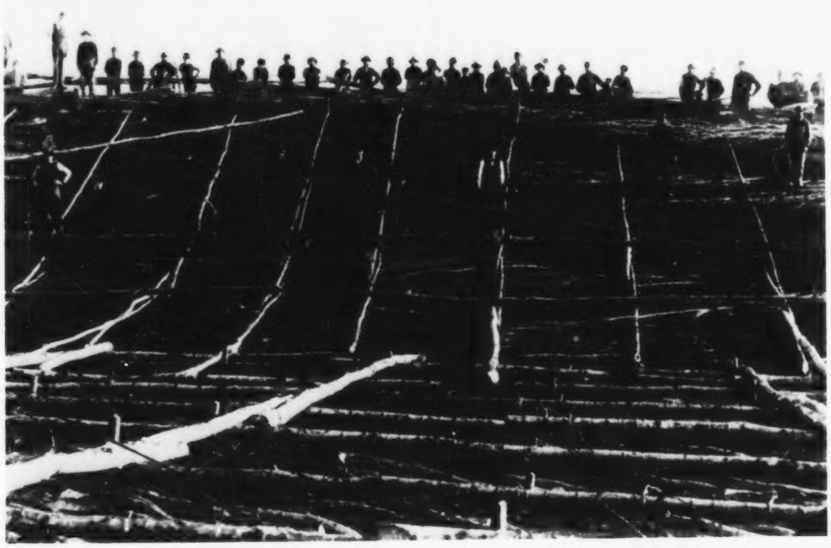
Flood Control



Public Affairs Office, Corps of Engineers

Early levee construction.

Fascine matting on a Mississippi River levee, 1885.



Public Affairs Office, Corps of Engineers

Congress did not authorize a comprehensive topographic and hydrographic study of a major river basin until 1850, when floods along the Mississippi River drew congressional attention to the need for a practical plan for flood control and navigation improvements at the river's mouth. The Secretary of War, Charles M. Conrad, sent Lieutenant Colonel Stephen H. Long and Captain Andrew A. Humphreys, two officers of the Corps of Topographical Engineers, to the Mississippi basin to conduct the survey. Charles S. Ellet, Jr., one of the best-known engineers of the day, also applied to make the delta survey. Conrad suggested that Ellet work with Long and Humphreys, but Ellet preferred to work independently. Under pressure from some congressmen and after seeing President Millard Fillmore, Conrad relented, dividing the $50,000 congressional appropriation between the Army survey and Ellet's.

Before the Army survey was complete, Humphreys became quite ill and had to quit. Long drafted a report based on Humphreys' notes, but he confined it simply to an exposition of what had been done without offering any specific recommendations. Therefore, Ellet's essay became the first comprehensive study of flood control on the Mississippi. Both reports were sent to Congress in January 1852. What distinguished Ellet's submission was the author's insistence on both the practicability and value of build-

Flood refugees flee to the levees in Hickman, Kentucky, 1912.

Historical Division, Corps of Engineers

Historical Division, Corps of Engineers

Shoring up a levee near Memphis, 1927.

ing reservoirs on the Mississippi's tributaries to reduce flooding. That recommendation prompted Colonel John J. Abert, Chief of the Corps of Topographical Engineers, to write, "While I willingly admit that all the speculations of a man of intellect are full of interest and deserving of careful thought, yet I cannot agree with him that these reservoirs would have any good or preventive effects upon the pernicious inundations of this river . . . ."

Nine years later Humphreys elevated Abert's comment to official Corps policy. After a long convalescence and subsequent work on western railroad surveys, Humphreys took up his task once more in 1857, this time with the assistance of Lieutenant Henry L. Abbot. Abbot supervised a party that took gauge readings, determined discharges at various points, measured cross-sections and reported on the state of various river improvements. When possible, he compared his data with that obtained by earlier survey parties. "In a word," Abbot later wrote, "the finger was to be firmly placed on the pulse of the great river, and every symptom of its annual paroxysm was to be noted." It was in the shadow of the Civil War that Humphreys and Abbot finally put their 500-page report together. They submitted it to the Chief of Topographical Engineers in August 1861, a few months after the firing on Fort Sumter. Humphreys was technically the report's author, but he insisted on listing Abbot as coauthor in recognition of Abbot's diligence and skill.

Humphreys' and Abbot's *Report Upon the Physics and Hydraulics of the Mississippi River* not only contained much new data about the Mississippi, but also analyzed other alluvial rivers around the world. The authors introduced entirely new formulations to explain river flow and sediment resistance and concluded that Ellet's calculations and assumptions were erroneous. Their own position, based on significantly more information, was that "levees only" could prevent flooding on the Mississippi. Neither reservoirs nor cut-offs were needed. Already a member of the American Philosophical Society, Humphreys received numerous honors for his work on hydraulics. He was made an hono-

JOE REILLY
MENS
CLOTHES
St. Louis District files, Corps of Engineers

Flood at Greenville, Mississippi, 1927.

The Corps of Engineers: Dam Destroyers?

On January 15, 1907, Major William Sibert, Pittsburgh district engineer, learned the depressing news that heavy flooding was undermining the abutment of Allegheny River Dam 3. If the dam continued to hold, which seemed likely, the flooding would gradually undermine the bank, thereby threatening a railroad track and a million dollar glass factory. Already nine homes, various outbuildings, and 5.3 acres of land had caved into the river. After long and undoubtedly agonizing discussion with his staff, Major Sibert made his decision: the dam would have to go. To allow the water to continue around the dam was to invite further catastrophe. The next morning blasting began. Five-hundred-pound dynamite charges were placed along the dam crest, and dynamiting continued until a 560-foot section at midstream had been removed. Then stones were placed along the bank to protect the glass factory and the railroad.

On January 30, the *New York Sun* printed an editorial which attacked the lack of progress on waterway projects. However, the editors noted, "no charge of dilatoriness can be brought against the officer who a few weeks ago saved a million dollars worth of property by assuming the responsibility of blowing up $80,000 worth of dam." Sibert became perhaps the only Corps officer ever commended by the Chief of Engineers for blowing up a government dam. His courage, imagination and ability to bend to circumstances set high standards for his successors at the Pittsburgh District Office.

Flood victims of Arkansas City, Arkansas, camp on a levee, 1927.

rary member of the Imperial Royal Geological Institute of Vienna in 1862 and a fellow of the American Academy of Arts and Sciences in 1863. The following year he was elected an honorary member of the Royal Institute of Science and Arts of Lombardy, and in 1868 Harvard College conferred upon him the degree of Doctor of Laws.

In considering navigation and flood control as interrelated problems Humphreys, Abbot, Ellet and other engineers in the United States and many in Europe were ahead of their time. By 1879 growing pressures for navigation improvements and flood control prompted Congress to establish the Mississippi River Commission—a seven-member organization responsible for executing a comprehensive plan for flood control and navigation works on the lower Mississippi. This permanent body of experts included three members from the Corps of Engineers, one from the Coast and Geodetic Survey, and three civilians, two of whom had to be civil engineers. The creation of this river basin authority marked the federal government's growing commitment to the development of a reliable inland waterway system. Initially, Congress authorized the commission to build and repair levees only

High water at Pine Bluff, Arkansas, 1927.

The Bicycle Flood Fight, 1897

The Fourth Engineer District at New Orleans received word in early 1897 that a major flood was southbound on the Mississippi. Major George M. Derby, district engineer, and civilian assistant W. J. Hardee prepared to defend the levees along more than 450 miles of river in the Fourth District. As had become customary by 1897, they stationed barges and quarterboats loaded with tools, sandbags and lumber at roughly 15-mile intervals along the river with towboats assigned to each 60-mile section.

During previous flood emergencies, Fourth District personnel had encountered great difficulty maintaining regular patrols of the levee system and coordinating the work of five other agencies: individual planters, railroads, parish governments, levee districts and state government. Backwater and washouts had closed roads and railroads; there then were no motorized vehicles available, and the towboats moved too slowly and usually too far from the levees for proper inspection. In order to improve coordination and inspection, Hardee equipped field personnel with bicycles, and during the subsequent flood fight the inspectors kept constantly on the move atop the levee crowns on their new transportation equipment. Hardee personally covered as much as 30 miles of levee a day on his bike, including stops for observation (and presumably to catch his breath).

Public Affairs Office, Corps of Engineers

Carbide lamps illuminate sandbagging operations on Mississippi ring levee, 1944.

if the work was part of a general navigation improvement plan. Monumental floods in 1912 and 1913, however, drew national attention to the need for federal flood relief legislation. Finally, in 1917 Congress passed the first flood control act. This legislation appropriated $45 million for flood control on the lower Mississippi and $5.6 million for work on the Sacramento River.

The report of Humphreys and Abbot enormously influenced river engineering in the United States. Until 1927, when a catastrophic flood hit the lower Mississippi, the Corps' position was that "levees only" could control flooding on the river. The Corps was not unalterably opposed to reservoirs. Several were built on the upper Mississippi, but principally to aid navigation. Advocates of reservoir construction also received support in 1897 from Captain Hiram S. Chittenden of the Corps of Engineers. Chittenden's essay, *Preliminary Examination of Reservoir Sites in Wyoming and Colorado*, submitted in response to a congressional directive, was a comprehensive and lucid presentation of engineering, physiographic and economic data. In it Chittenden declared that reservoir construction in the arid regions of the West was "an indispensable condition to the highest development of that section." He also warned, "The function of reservoirs will always be primarily the promotion of industrial ends; secondarily only, a possible amelioration of flood conditions in the rivers." So far as the Mississippi was concerned, "the difficulty was not so much a physical as a financial one." He identified a few potential reservoir sites in the Mississippi basin, but thought that flood control alone would never justify construction. He also examined the various methods of constructing reservoirs, noting that the arched dam, first constructed in France in the 1860s, showed promise for use in the West. Finally Chittenden boldly proposed that public agencies, mainly federal, be charged with the responsibility for reservoir development.

With the passage of the Mississippi River and Tributaries Act in 1928, the federal government became firmly committed to flood control on the Mississippi. This act resulted from the public response to the flooding the year before, which had taken between 250 and 500 lives in the lower Mississippi basin, had flooded more than 16 million acres and had left over half a million people requiring temporary shelter. Two reports were submitted to Congress recommending ways to prevent future disasters of this magnitude, one by the Mississippi River Commission and the other by the Chief of Engineers, Major General Edgar Jadwin. Principally because Jadwin promised equal protection for less than half the money, Congress accepted his plan. This time there was no dispute about levees. The 1927 flood demonstrated the bankruptcy of the "levees only" policy. In addition to levees, Jadwin proposed a mix of floodways and spillways, including the much discussed Bonnet Carré spillway connecting the Mississippi with Lake Pontchartrain. Also included in the plan was the controversial idea of sending about half of the Mississippi's flood waters down the Atchafalaya River into the Gulf of Mexico. This was an idea which Humphreys and Abbot had deemed

Public Affairs Office, Corps of Engineers

Floodwater over Bonnet Carré spillway.

Sandbagging.

Public Affairs Office, Corps of Engineers

"virtually impracticable," but the Atchafalaya had greatly enlarged over the years so that most engineers now considered the proposal workable. On the other hand, Jadwin stood firmly in the tradition of his predecessor in his opposition to reservoirs. He had established a special Reservoir Board of engineer officers to examine the subject and the board had concluded that Jadwin's plan was "far cheaper than any method the board has been able to devise for accomplishing the same result by any combination of reservoirs."

Nevertheless, the idea of locating reservoirs on the lower Mississippi was far from dead. In fact, the Corps' own work stimulated interest in the subject. In 1927 Congress authorized the Corps to survey the country's navigable streams in order to formulate plans for the improvement of navigation, water power, flood control, and irrigation. The surveys came to be called "308 reports," named after Congressional Document 308 in which the Corps and the Federal Power Commission had jointly presented to Congress the estimated cost for the reports. Soon after funds were appropriated, Corps district offices around the country proceeded with the surveys. Having dispensed with the main stem of the Mississippi in the Jadwin plan, district engineers along the lower Mississippi directed their attention to the major tributaries. Not surprisingly, they concluded that construction of reservoirs along such streams as the Yazoo and St. Francis, while contributing to local flood control, would not be cost effective. This position proved increasingly politically unpopular in the midst of growing unemployment resulting from the Great Depression. Public works projects, once considered uneconomical, began looking very attractive as a means of employment. Moreover, many politicians felt that flood control was essential to protect human life no matter what the economists said. Mainly reacting to this political interest, the Corps reversed its position on a number of flood control projects. Revised reports concluded that the necessity for "public-work relief" and the suffering caused by recurring floods provided grounds for construction.

The 1936 Flood Control Act recognized that flood control was "a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof." Responsibility for federal flood control projects was given to the Corps of Engineers, while projects dealing with watershed run-off and soil erosion were assigned to the Department of Agriculture. This law made the Corps responsible for flood control throughout the nation, working in cooperation with the Bureau of Reclamation. In the years following passage of this law, the Corps built, pursuant to congressional authorization and appropriation, some 300-400 reservoirs whose primary benefit was flood control. However, it is inconceivable that these reservoirs would have been built had flood control been the only benefit. In the age of multipurpose projects, possible navigation, water storage, irrigation, power and recreation benefits are considered before a final economic benefit figure can be reached.

The Benefits of Military Training: Colonel Eugene Reybold and the 1937 Flood

During the 1937 floods on the Ohio and Mississippi Rivers, Lt. Col. Eugene Reybold, district engineer at Memphis, used his military expertise to combat the record high waters. Reybold's district embraced the Mississippi and its tributaries from Cairo, Illinois, to the mouth of the Arkansas River. In January, rain equal to half the normal annual precipitation fell on the Ohio Valley, causing record floods at every point on the Ohio River and sending raging waters rushing down the Mississippi. The ground was frozen and the runoff rapid. The waters threatened Cairo and the valley below.

Reybold drew upon his training at the Command and General Staff School and the War College to deal with the situation. He wrote an estimate of the emergency and organized a defensive position against the unpredictable and treacherous enemy. He called upon the St. Louis and Kansas City districts for boats equipped with radios and drew experienced flood fighters from all districts. The commanding general of the 4th Corps Area in Atlanta supplemented the floating radio network with Army Signal Corps units equipped with field radios and telephones. Reybold had communications available for practically every mile of main levee in his district. Finally, he set up Red Cross Headquarters in Memphis to take care of the anticipated flood refugees.

From his command post in the district office in Memphis, Reybold directed his forces against the approaching enemy. There were many dark moments, but Reybold promptly learned of each and every weakness in the levees and quickly had them reinforced. "My military training," he later observed, "and similar training of countless engineer officers sent to my assistance had a lot to do with the safe passage of the greatest flood the lower Mississippi Valley ever experienced."

Hydropower Development

Brigadier General
Alexander Mackenzie.

Libby Dam, Montana

Public Affairs Office, Corps of Engineers

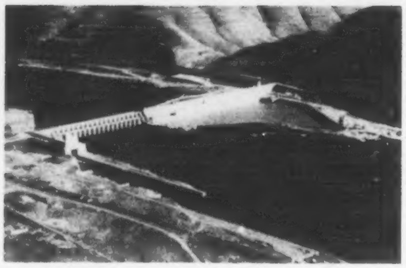
Since the turn of the 20th century, the U.S. Army Corps of Engineers has moved from a position opposing involvement in hydroelectric power to one of total endorsement. By 1900 Congress had already initiated partial federal control over dam-building. The Corps participated in the regulatory process but conceived its role narrowly.

In January 1905 Brigadier General Alexander Mackenzie, the Chief of Engineers, summed up the Corps' traditional views on the federal government's limited role in improving American waterways. Congress, he said, could legally "exercise control over the navigable waters of the United States . . . only to the extent necessary to protect, preserve, and improve free navigation." Mackenzie further maintained that nothing should be permitted to interfere with the central purpose of locks and dams—to facilitate navigation and commerce. All other interests were clearly secondary. These views fitted into the prevailing judicial interpretation of federal powers under the Constitution's commerce clause.

During the years following Mackenzie's pronouncements, attitudes gradually changed. The engineers became convinced that the escalation in private dam-building, largely for hydropower purposes, threatened to jeopardize their prerogatives in navigation work and they guarded those prerogatives jealously. While the federal government redefined its part in water

Generators at Bonneville Dam.

Public Affairs Office, Corps of Engineers



Public Affairs Office, Corps of Engineers

John Day Lock and Dam.

resources development, the Corps staked out its own territory. As an auxiliary to navigation and later to flood control, hydropower benefited by more liberal interpretations of federal authority. Cautiously, with frequent hesitation and some inconsistency, the engineers embraced the new philosophy. What began as a regulatory role in hydropower expanded to include much more. By mid-century, the Corps of Engineers emerged as the largest constructor and operator of federal power facilities.

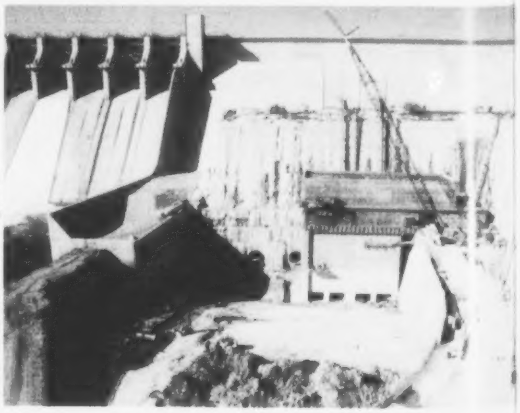
The change in the engineers' role was dramatic by the end of the 1920s. By that time, they were heavily involved in surveying rivers for flood control, power and irrigation, as well as for navigation. Public power at multipurpose projects took hold during the New Deal and proliferated after World War II. In the mid-1950s, the Corps had more than 20 multipurpose projects under construction. By 1975 the energy produced by Corps hydroelectric facilities was 27 percent of the total hydroelectric power production in the United States and 4.4 percent of the electrical energy output from all sources. In 1982 the Corps had just under 100 projects with existing hydropower facilities or facilities under construction. The total capacity at Corps dams was about 19.2 million kilowatts. The largest hydropower dams built by the Corps are on the Columbia and Snake rivers in the Pacific Northwest. The biggest of these is the John Day on the Columbia River, which has a generating capacity of nearly 2.2 million kilowatts.

In 1951 the Chief of Engineers referred to the development of hydropower as "one of the most important aspects of water resource development." Further, he argued, "proper provisions for hydroelectric power development are an essential part of comprehensive planning for conservation and use of our river basins for the greatest public good." Nearly 20 years later, the Office of the Chief of Engineers reaffirmed its commitment, stating that "generation of hydroelectric power to serve the growing needs of the American people is a task the Corps welcomes." The Corps' turnabout and its expanding mission in hydroelectric power development are a significant part of the organization's history in the 20th century.

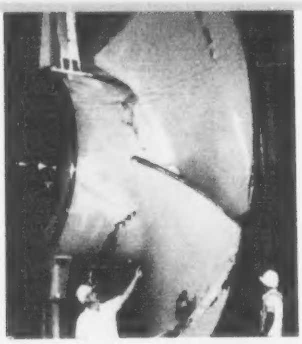
Public Affairs Office, Corps of Engineers

Bonneville Dam, Oregon.

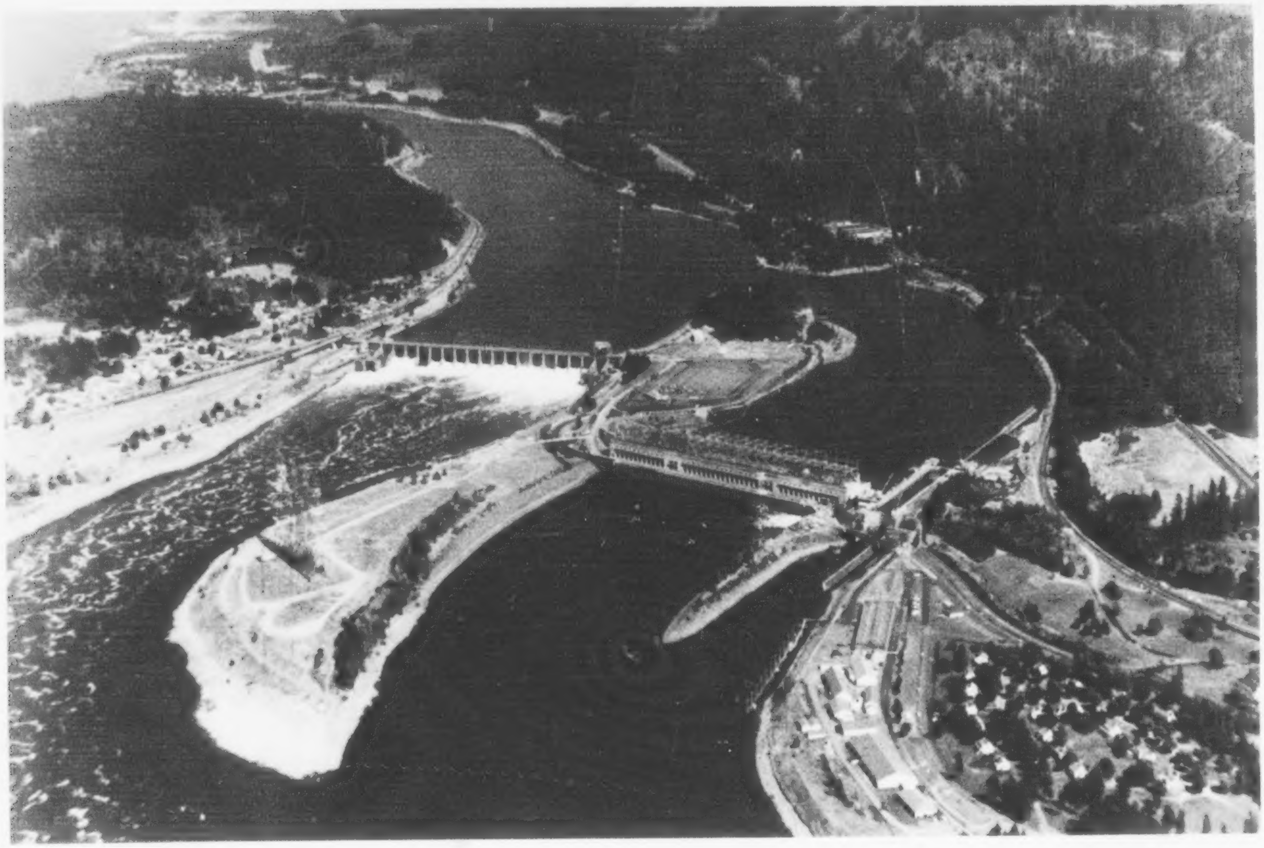
Fort Peck Dam, Montana



Missouri River Division, Corps of Engineers



Power house turbine blade under repair.



Clark Hill Lake and Dam, Georgia and South Carolina.

Powerhouse construction, Richard B. Russell Dam on the Savannah River, 1982.

The Environmental Challenge

Mirror Lake, Yellowstone, 1880.

As explorers and mapmakers for the pioneers, the engineers were among the first to recognize the need for protection of natural resources. As early as the 1840s, when the vast herds of buffalo seemed limitless to most travelers, engineer officers warned of their impending destruction. Captain Howard Stansbury noted their shrinking ranges and warned that the buffalo "seem destined to final extirpation at the hands of men." These officers were nearly correct, but one of the few surviving buffalo herds today is protected at a Corps of Engineers project.

The Corps of Engineers was also influential in the creation of the first national park at Yellowstone in 1874, and the Corps operated and protected that park for many years. Captain William Ludlow and an engineer survey party at Yellowstone in the 1870s confronted tourists, harbingers of the future, carving their initials, scattering their rubbish and breaking off pieces of rock formations. Alarmed, Ludlow pleaded with the visitors to respect nature's work. He stopped one woman, poised with a shovel over a mound formed over thousands of years by a bubbling spring's mineral deposits, in time to prevent her smashing the formation. In his report, Ludlow proposed several ways to protect the new park. His recommendations, including military patrols and engineer construction of roads, were adopted. Thanks to Ludlow, who provided the blueprint for saving the park, Yellowstone remains among the crown jewels of America's scenic wonders.

To prevent the obstruction of navigable waterways, Congress in the 1870s directed the Corps to regulate the construction of specific bridges. The job was expanded during the 1880s and '90s to prevent dumping and filling in the nation's harbors, a program that was vigorously enforced by the engineers. At the port of Pittsburgh in 1892, for instance, the Corps took a grand jury on a boat tour of the harbor and obtained some 50 indictments of firms dumping debris into the harbor. When the engineers learned that firms were piling debris on the streambanks during the day and pushing it into the harbor at night,

Historical Division, Corps of Engineers

Original Baronett Bridge, first across the Yellowstone River, built in 1871.

National Archives

Buffalo grazing at Yellowstone, 1880.

Public Affairs Office, Corps of Engineers

Assessing a "sea curtain" for containing oil spills.

they began night patrols in fast boats with searchlights.

In 1893 a citizen of an Ohio River city complained to the Corps that the city was dumping into the river "household garbage, refuse of wholesale commission and slaughter houses, wagon loads of decaying melons, fruit and vegetables and carcasses of animals." The city officials replied that the complaint was exaggerated—very few dead animals were dumped in the river—and refused to stop the practice because the city then would have to build incinerators to dispose of the refuse. The Corps managed to stop the dumping anyway, forced the city to build an incinerator and prosecuted the offenders, arguing that the garbage formed piles sufficient to obstruct navigation.

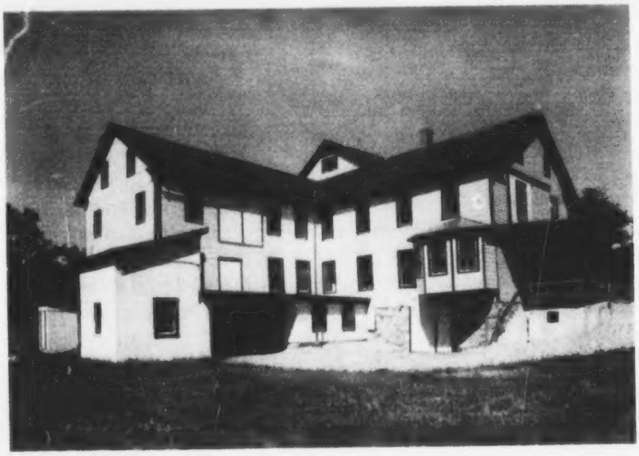
In the Rivers and Harbors Act of 1899, Congress gave the Corps the authority to regulate almost all kinds of obstructions to navigation. The engineers were disappointed that they were not also given authority to deal with polluters, for many of their personnel lived on the waterways on a daily basis and water quality was an immediate personal concern.

The Corps used the Rivers and Harbors Act of 1899 to the fullest extent legally possible to protect the environment of navigable waterways. In one extreme instance the Corps managed to stop a firm from discharging a liquid effluent into a waterway by contending in court that the discharge obstructed navigation because it entered steamboat boilers and corroded them to the extent that repairs were necessary. The Oil Pollution Act of 1924 gave the Corps the responsibility of insuring that offensive and dangerous oil discharges did not pollute the nation's harbors. However, the Corps could not adequately control the problem because of lack of regulatory power and insufficient manpower, and Corps officers periodically urged Congress to grant the agency adequate authority and resources.

The Corps' regulatory authority was expanded by the Clean Water Act (Federal Water Pollution Control Act) of 1972 to include all waters of the United States. The Corps began to regulate discharges of dredged or fill materials into any waters of the United States and the permit program that resulted gave environmental protection the fullest consideration. "We would like to commend the Corps for the will with which it is turning to carrying out the responsibilities Congress gave it in Section 404 for protecting the water quality on which the health and economic well-being of every American depend," said a member of the Natural Resources Defense Council.

Along with protective measures for the environment, the Corps at its authorized projects pursues an active program for the preservation of cultural resources. Recent legislation stipulates that up to one percent of the funds for a project can be expended for cultural resource surveys, for artifact and data recovery, and for mitigation efforts. The Corps' cultural resource preservation effort has had substantial results. For example, the Corps relocated a navigation lock on the Tennessee-Tombigbee Waterway to avoid destroying an Indian burial ground; and in Pennsylvania the Corps moved a unique 19th-century wagon works from a project area to preserve it. To avoid accidental destruction of archeological sites, the Corps is searching for the homes of ancient tribes, especially along the coasts where dredge disposal sites are needed.

The Corps' responsibility for improving and maintaining navigation on the nation's waterways requires the dredging of channels if they are to remain open. In 1969 the dredging program was attacked as environmentally unsound. "All of a sudden, dredging became a four-letter word," remarked Lieutenant General John Morris of the Corps. "Now this came as rather a surprise to us," he continued, "since dredging has been a daily activity within the Corps for 150 years and nobody paid much attention to it."



Restored Gruber Wagon Works, Bucks County, Pennsylvania.

The Dalles, Oregon.

Public Affairs Office, Corps of Engineers

In 1970 the Corps began a dredged material research program to identify dredging and dredged disposal systems that would be compatible with the new environmental protection mission. Completed in 1978, the dredged material research program reversed some traditional thinking about the effects of dredging. It indicated that dredging need not have adverse impacts on aquatic life and that dredged materials can create new wetlands and wildlife management areas. The research identified improved methods for constructing diked disposal areas and for using physical, chemical and biological agents in the dredging process and it demonstrated that dredged fill can be used to reclaim strip-mined lands and other environmentally damaged areas.

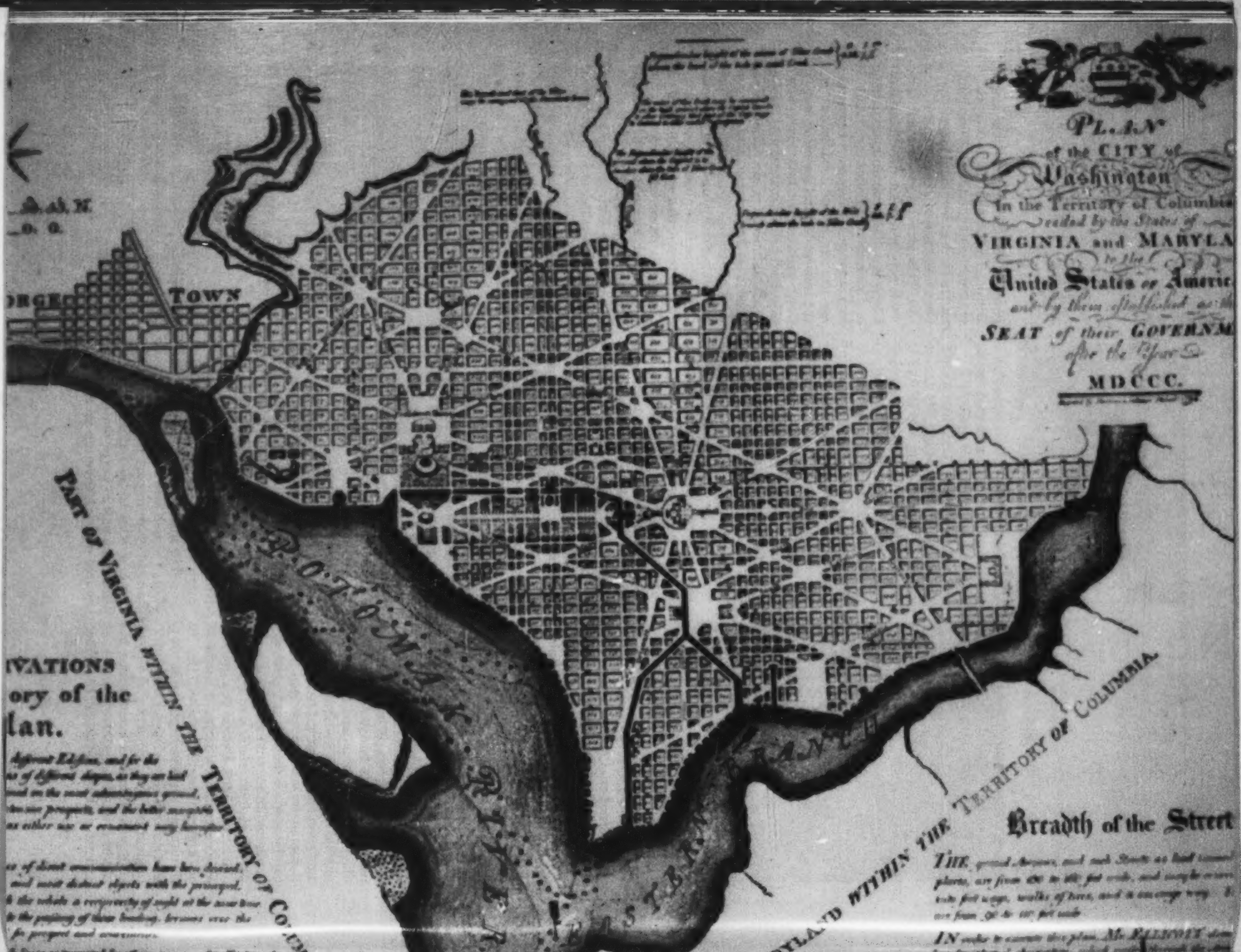
Streambank erosion can have major detrimental impacts on the environment and human welfare. It results in sediment deposits in reservoirs and waterways; it impairs navigation, flood control and water supply project effectiveness; it blights valuable recreation areas and streambank lands. Since 1969 the Corps has conducted intensive studies of streambank erosion, with demonstration control projects along the Missouri, Ohio and Yazoo rivers, in an effort to identify the causes of such erosion and to find new techniques for bank protection. The studies of this form of environmental degradation have identified the causes of streambank erosion and have indicated some potential new techniques for its control.

The Corps' coastal engineering research program since 1969 has devised some innovative approaches to the problems of beach erosion, coastal storm damages and navigation along the coastline. Analysis of wave patterns has opened the way to rational design of rubble mound structures for the protection of threatened beaches and coastline. Possible uses for beach and marsh grasses in control of coastal erosion have been identified. And the research has established some basic relationships governing the size and shape of coastal inlets and harbor entrances.

Fish and wildlife conservation has been a concern of the Corps since Captain Stansbury warned that the buffalo were disappearing. The engineers built the first federal fish hatchery in 1874 and have included such features as fish ladders in project planning for many years. Corps projects are designed to minimize damage to fish and wildlife resources, and the Corps enhances wildlife resources at its projects through effective wildlife management. Approximately 2.5 million acres of land are primarily used for fish and wildlife purposes; one-fifth of this land is managed by other federal and state agencies in cooperation with the Corps.

The intense interest of the Corps in fish and wildlife management derives in part from the program's value to the recreational functions at 426 Corps water resource projects covering an aggregate of more than 11 million acres. During 1979, 449 million visitors enjoyed fishing, hunting, swimming and other water-related sports at Corps recreation areas.

Through its floodplain management program begun in 1960, the Corps provides technical services and planning guidance for many local agencies and groups to encourage prudent use of floodplains. At the request of local agencies, the Corps studies specific areas to identify flood hazard potentials, to establish standard project floods and flood frequency curves, and to map the floodplains. The resulting information is used by the local agencies to regulate floodplain development, even to the extent of evacuating floodprone areas and converting them to recreation parks or fish and wildlife habitats.


PLAN
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Work in the District of Columbia

Cabin John Bridge.

Historical Division, Corps of Engineers

Montgomery C. Meigs.

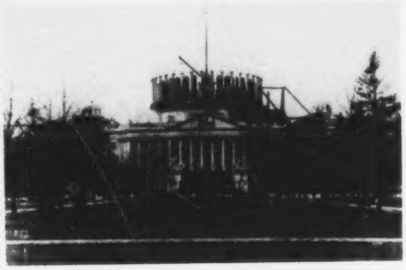
Army engineers contributed to both the planning and construction of the nation's capital. From early bridges to the modern subway system, Corps officers and civilians helped plan and construct Washington's transportation system, city monuments and public buildings. Parks, water supply and sewage systems, flood control structures and public health measures in the city were or still are the engineers' responsibility. Army engineers served as administrators as well as construction experts. Their influence and responsibilities declined only as civilian agencies assumed control of certain activities and home-rule movements lessened federal responsibility for public works in Washington.

In 1791 former Army Engineer Pierre Charles L'Enfant designed the master plan for the new capital. Other Army engineers designed and built fortifications for the city. The British army destroyed those defenses as well as the partially built Capitol building during the War of 1812. Chief Engineer Joseph G. Swift and engineer Lieutenant Colonel George Bomford helped rebuild the Capitol. In 1822 Major Isaac Roberdeau, a topographical engineer, supervised the installation of cast iron pipes to bring spring water to the White House and the executive offices around it. In the 1850s, Congress funded the construction of a permanent water supply for the cities of Washington and Georgetown. Eventually placed under the supervision of engineer First Lieutenant Montgomery C. Meigs, the project evolved into what is today the Washington Aqueduct Office of the U.S. Army Engineer District, Baltimore. Meigs' plans included construction of two bridges to carry traffic as well as water pipes, one over Cabin John Creek and one over Rock Creek. Both bridges were engineering feats of their time and the Cabin John Bridge remains in use. This bridge, begun in 1857 and completed in 1864, held the world's record for 40 years for having the longest masonry arch in the world.

Meigs and other engineer officers also reconstructed the United States Capitol, fireproofed the Smithsonian Institution and rebuilt or repaired bridges and streets. Us-

National Archives

Andrew Ellicott's plan of Washington, D.C. 1792.



U.S. Capitol dome, December 31, 1857.

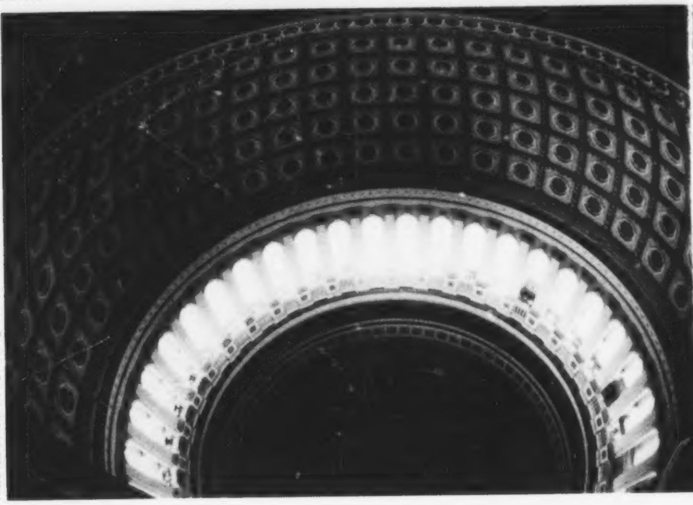
Public Affairs Office, Corps of Engineers

ing new techniques, Meigs provided the first adequate heating and ventilation system for the home of Congress. As Meigs' construction of the two new wings of the Capitol progressed, the old dome began to look disproportionately small. Under congressional mandate, Meigs designed a new dome consisting of cast and wrought iron, weighing almost nine million pounds. President Abraham Lincoln used the completion of that dome during the Civil War as a symbol of his intention to preserve the Union.

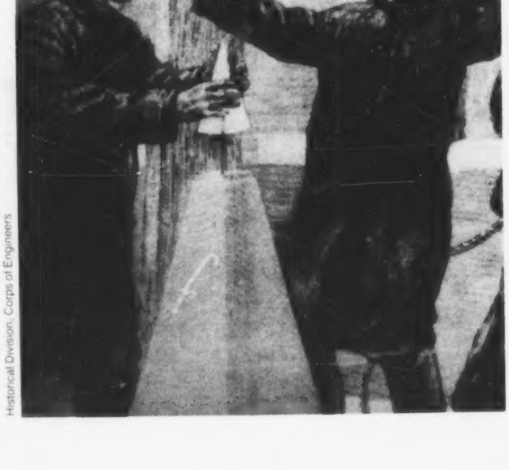
After the Civil War, Corps officers and civilians designed and built many of the monuments and public buildings that decorate Washington today. At the request of the Senate, Major Nathaniel Michler surveyed sites for a new park and a new location for the White House. His praise drew attention to Rock Creek Valley. Later, the Chief of Engineers, Brigadier General Thomas L. Casey, and other officers worked for and supervised the development of that large urban park.

Congress continued to institutionalize the Corps' role in the District. In 1867 the legislators removed control of public buildings from civilian hands and gave it to what became the Office of Public Buildings and Grounds under the Chief of Engineers. In 1878 Congress permanently replaced Washington's elected government with a three-man commission. An Army engineer holding the title of Engineer Commissioner for the District of Columbia served on that governing board with responsibility for the city's physical plant. Meanwhile, other engineer work in the District grew to the extent that the Chief of Engineers, Brigadier General Andrew A. Humphreys, established in 1874 the United States Engineer Office, Washington, under the civilian engineer Sylvanus T. Abert, to carry out navigation improvements on the Potomac River and its

Interior of the Capitol, photographed from the dome.



Historical Division, Corps of Engineers

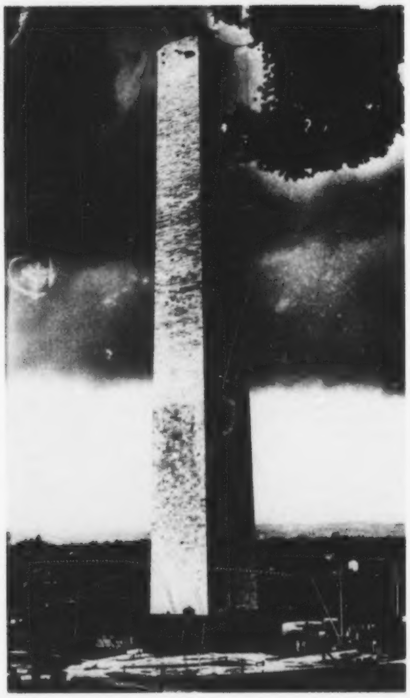


Historical Division, Corps of Engineers

Thomas L. Casey prepares to set aluminum apex for Washington Monument, from a sketch made for *Harper's Weekly*.

Public Affairs Office, Corps of Engineers

Library of Congress under construction, 1888.



National Archives

Washington Monument, February 1884.

tributaries.

Two years later, Congress asked the Corps to complete the Washington Monument, left partially built by its bankrupt sponsors. Then Lieutenant Colonel Thomas Casey and his assistant, Bernard Green, corrected major problems with its foundation, redesigned it and supervised its completion. The construction culminated in December 1884, with the placing on its tip of a pyramid of 100 ounces of aluminum, the largest piece yet cast of the new metal. Casey and Green went on to help design and supervise the construction of the State, War and Navy Building next to the White House. It is now the Executive Office Building. The two men also helped design and construct the Library of Congress.

Between the 1880s and the 1920s, Corps dredge and fill operations not only protected Washington from Potomac and Anacostia river floods, but also created waterfront park land. Potomac Park, Washington Channel with its adjacent recreation areas and the land for the Lincoln and Jefferson memorials all are products of this river improvement and swamp reclamation work. The attractive tidal basin in front of the Jefferson memorial that automatically changes the water in the Washington Channel with the tidal flow is another product of this work.

Meanwhile Lieutenant Colonel William W. Harts of the Office of Buildings and Grounds took charge of the development of Rock Creek Park, which became a major resource for urban recreation and beauty. Harts also supervised the completion of three important memorials. In 1913 he directed the start of work on the new headquarters of the American Red Cross. The following year he oversaw the beginning of construction on the Lincoln Memorial and the Arlington Memorial Amphitheater and Chapel.

Public Affairs Office, Corps of Engineers

Daniel Chester French's Abraham Lincoln, Lincoln Memorial, Washington, D.C.

The Corps also built or supervised the construction of practical and attractive buildings to house the government of the reunited nation, including the Government Printing Office and the Army War College at Fort McNair. In 1883 Meigs came out of retirement to build the Pension Building. Designed to house the offices providing pensions to war veterans, the building is so attractive that it is sometimes used for inaugural activities.

The George Washington Memorial Parkway, the Pentagon and National Airport began as pre-World War II construction projects of the Corps of Engineers. After World War II, the Corps was involved in the complete gutting and rebuilding of the inside of the White House, expanding the water supply for the District and planning for housing and transportation.

U. S. Grant III, grandson of the President, and other officers served on the planning boards that oversaw growth in the Washington metropolitan area. Gradually, civilian agencies such as the National Park Service began to assume responsibility for developing the buildings, streets, sewage systems and parks which the Corps had handled in addition to its ordinary activities.

Today, the Washington Aqueduct alone remains a special responsibility of the U.S. Army Engineer District, Baltimore. The Baltimore District also carries out all current civil works and military projects in the Washington area, such as the construction in the 1970s of a new hospital at Walter Reed Army Medical Center.

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N° 78

PLAN
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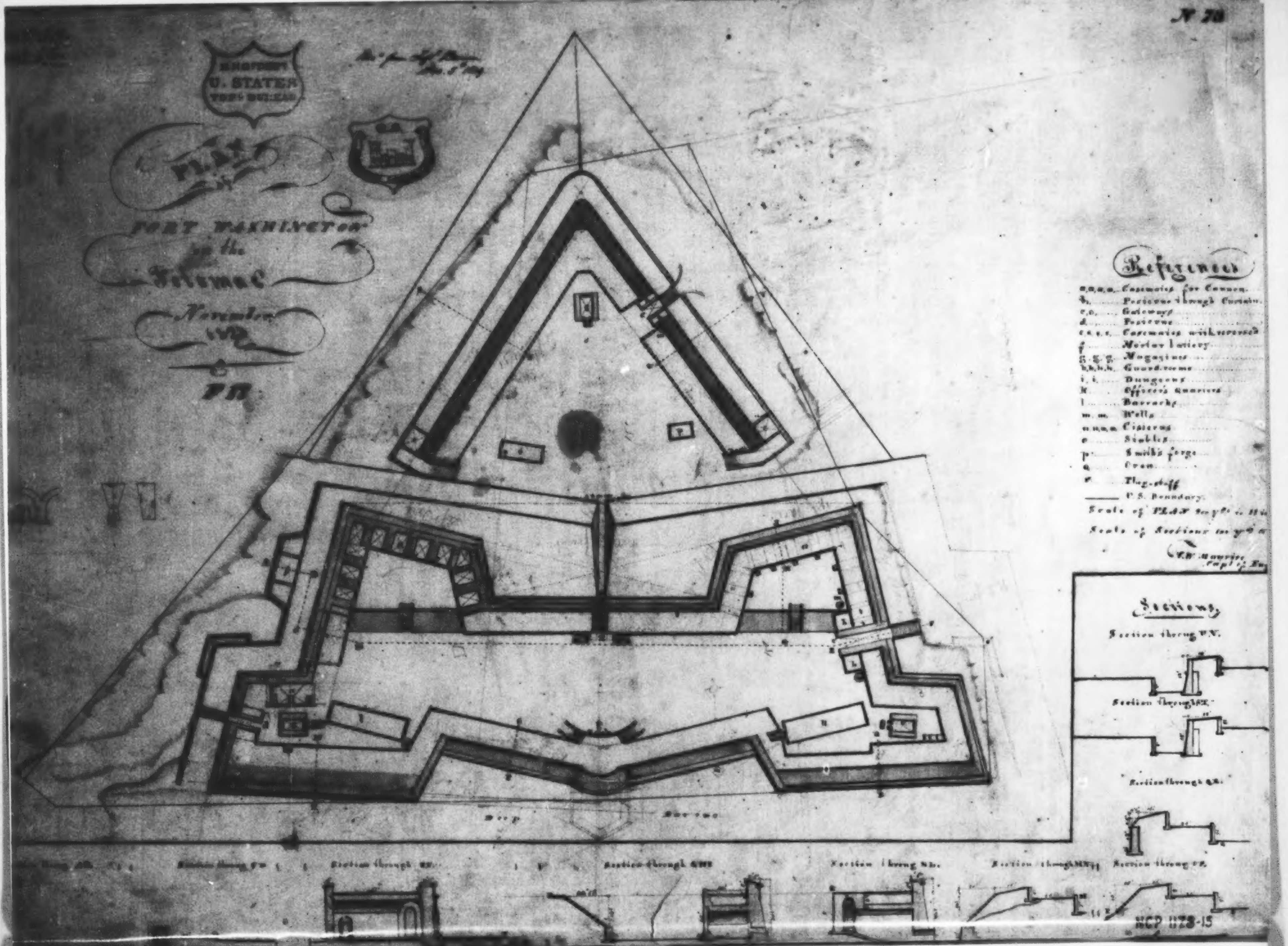
T.W.


Deep Ravine
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References

- a, a, a, a, … Casemates for Cannon.
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- f … Mortar battery
- g. g. g. … Magazines
- h, h, h, h, … Guard-rooms
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- k … Officer's Quarters
- l … Barracks
- m, m, … Wells
- n, n, n, n, … Cisterns
- o … Stables
- p … Smith's forge
- q … Oven
- r … Flag-staff
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Scale of PLAN 80 y^ds^ to 1 In

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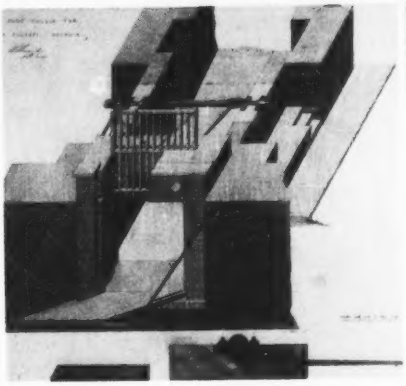
T.W. Maurice,
Capt. of Eng.

Sections

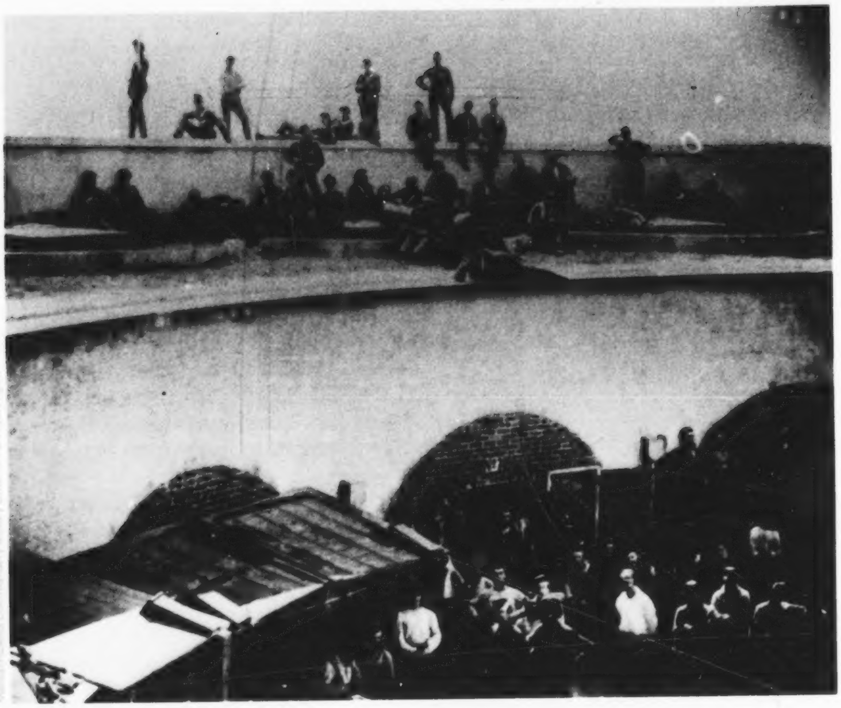
NCP 1128-15

Coast Defense



Plan for drawbridge and portcullis at Fort Pulaski c.1846

Civil War soldiers at Castle Pinckney, Charleston Harbor



When the American Revolution began in 1775, numerous coastal fortifications already existed along the Atlantic coast to protect communities from pirate incursions and enemy raids. The British Royal Engineers, as well as individual colonies and local communities, built these structures, which varied from crude earthen and wooden batteries to strong masonry forts.

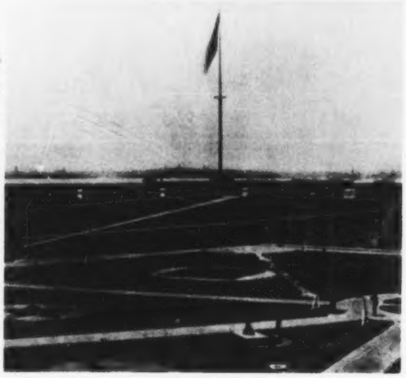
During the War for Independence, the combatants rehabilitated many of the existing coastal fortifications and constructed new ones. The small body of Continental Army Engineers accomplished some of the work. Then, when the war ended, the new country abandoned these works, deciding that the militia could man them, if necessary.

A decade later, in 1794, the United States, fearing attacks from other nations, undertook a construction program to provide fortifications for the protection of the major harbors and northern frontiers of the country. Until the 1860s, the Corps of Engineers planned and erected these works, which were often elaborate structures. Initially the Corps followed the prevalent French and British designs, but later developed its own, more modern ones. Fort Monroe in Virginia, Fort Adams in Rhode Island and Fort Washington in Maryland exhibit foreign influence while Fort Delaware, Delaware, and Fort Point, California, reflect American concepts.

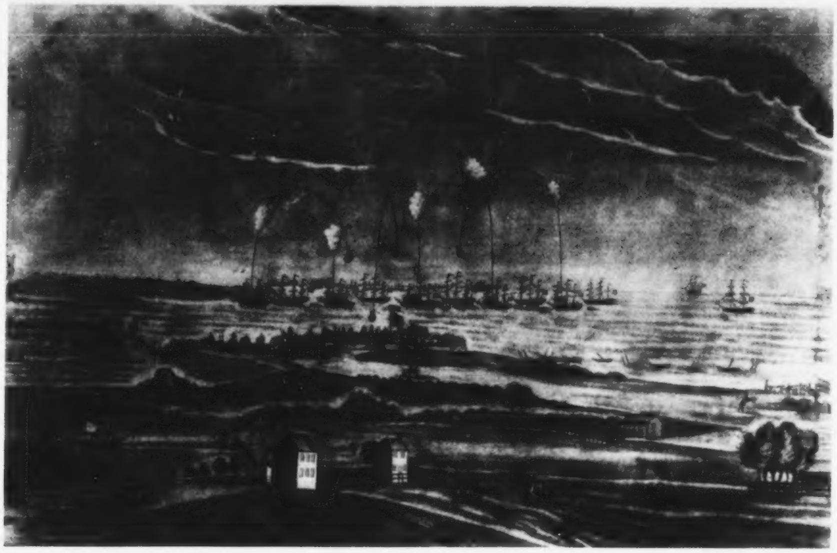
National Archives

Plan of Fort Washington, November 1823.

Interior of Fort Independence, Boston Harbor, 1864.



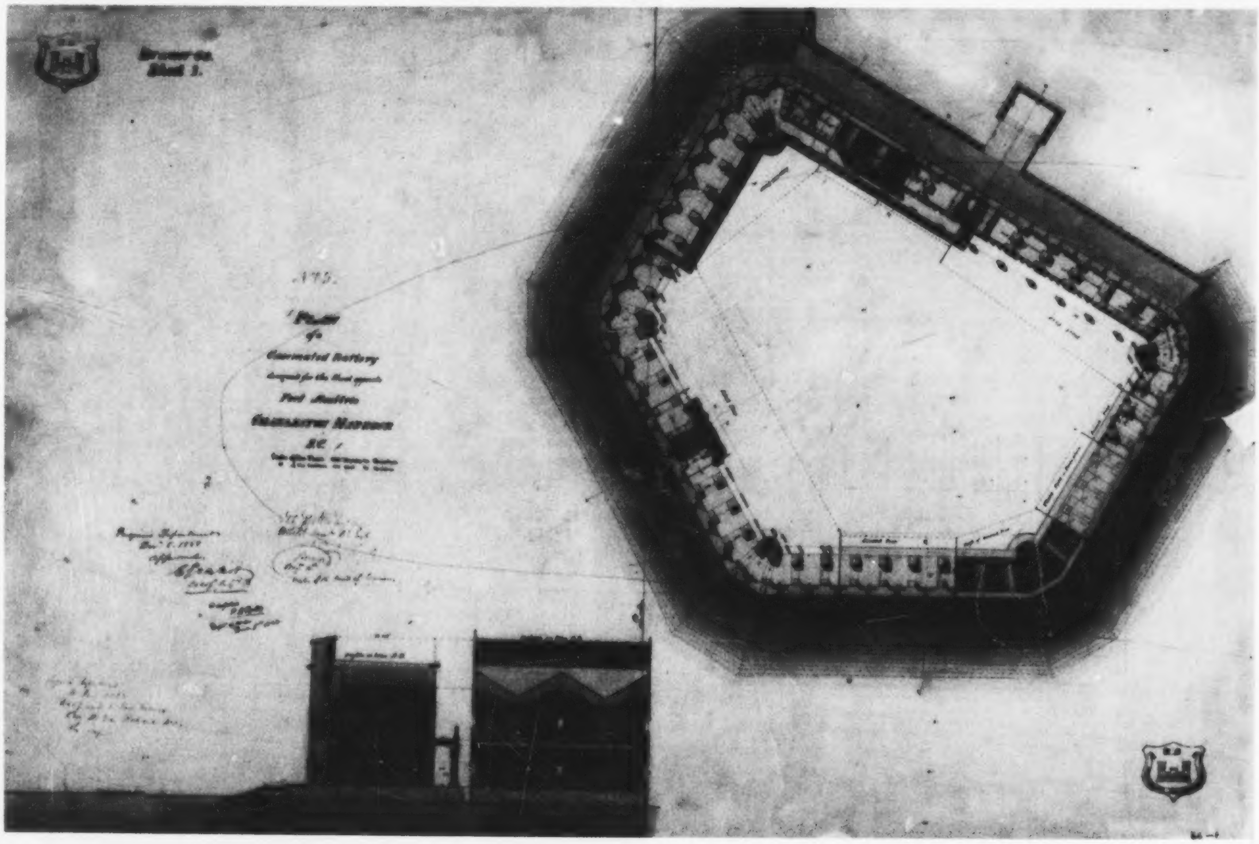
Massachusetts Commandery Military Order of the Loyal Legion



Library of Congress

Bombardment of Fort McHenry, aquatint by John Bower, undated.

Plan of casemated battery opposite Fort Moultrie, Charleston Harbor, c.1828.



National Archives

U.S. Military Academy Library

Inspection at Fort Monroe, Virginia, c.1900.

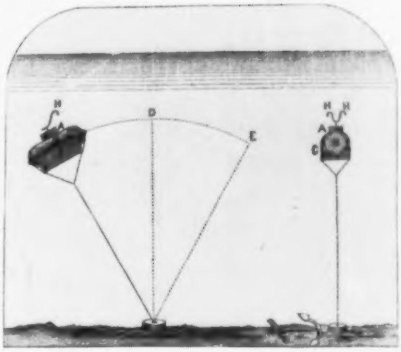
Although generally ungarrisoned, the country's coastal fortifications were a viable deterrent to foreign attack until the Civil War, when newly developed weapons rendered these defenses obsolete. Heavy rifled artillery, both land and naval, demolished brick, stone and masonry fortifications like Fort Sumter, South Carolina, and Fort Pulaski, Georgia. As a result, both Union and Confederate engineers began erecting coastal forts and batteries that were much more resilient to artillery fire.

Forsaking the outdated coastal fortifications, the engineers, acting upon a coast defense board's recommendations, began building concrete gun batteries to defend the coasts of the United States. Theoretically, long-range guns and mortars in these batteries would destroy enemy fleets before they reached a harbor. The Army engineers sometimes placed the batteries inside or in the immediate vicinity of old coastal forts. They purchased new land for others and with the acquisition of new territories at the end of the century, began erecting batteries in Hawaii, Panama and the Philippines. As artillery improved, the Corps constructed new batteries for bigger and more efficient guns.

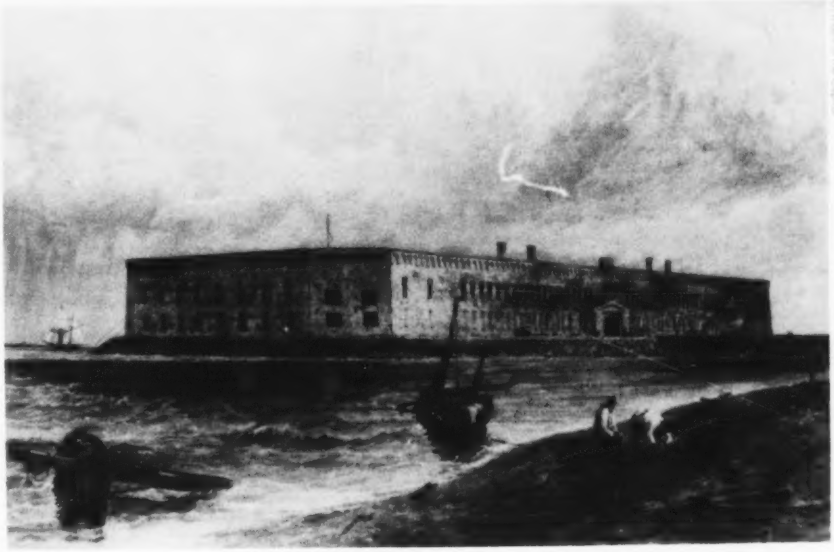
Later, after World War II, new weapons like the airplane and missile rendered the batteries obsolete. By 1950 the Army ceased using them for their original purpose. Today the remnants of these batteries dot the coast and often appear from a distance to look like concrete bunkers.

In conjunction with its fortification and battery construction programs, Army engineers had other coast defense responsibilities. In the 19th century, they placed obstructions in the bays, rivers and harbors along the coasts. Progressing from chains to submarine mines, these obstructions were to slow down or halt enemy vessels. Although the Coast Artillery Corps took over responsibility for submarine mines in 1901, the Corps continued to build casemates, storehouses, loading rooms and other structures for the mine defenses. The Corps also developed a protective concealment program for coast defenses evolving into the elaborate camouflage nets and paints in use during World War II.

Diagram of torpedo used in the War of 1812, from Benson J. Lossing's *The Pictorial Field Book of the War of 1812.*



U.S. Military Academy Library



Architect of the Capitol

Fort Sumter before the Civil War, from an oil painting by Seth Eastman.

Combat Operations

from the Mexican War to the Mexican Punitive Expedition

Union troops in gun emplacement, 1863

Major General Gustavus W. Smith (Civil War-era photo)

The Mexican War

On May 15, 1846, soon after the Mexican War began, Congress authorized the War Department to raise a company of engineers. This unit, the first regular Army engineer company, acted as sappers and miners during the arduous and lengthy marches of the war. It also erected siege batteries at Mexico City, an important contribution to the assault of that capital.

At the Battle of Contreras in August 1847, Lieutenant Gustavus W. Smith, then commanding the engineer company, asked for and received permission to participate in the attack. Smith and his men initially led the assault, which the commanding general halted and rescheduled for the next morning upon observing the arrival of enemy reinforcements. The next morning, the engineer company, along with a rifle regiment, attacked the Mexicans in the rear. Most of the enemy troops fled, but a few remained to fire grapeshot at the Americans from about 25 yards. Although partially shaken by the blast, the engineer company chased the fleeing Mexicans for some distance before receiving orders to return to the main army.

In all 44 engineer officers served in the Mexican War including Robert E. Lee, George B. McClellan, P.G.T. Beauregard and Henry W. Halleck. Practically all of these engineers served on the staffs of general officers and performed reconnaissance and intelligence work, especially around Mexico City.

Following the Mexican War, the engineer officers returned to peacetime duties, including fortification construction, exploration, surveying and river, harbor and road work. The engineer company, which spent a good deal of its time at West Point in the postwar period, did accompany some exploring expeditions to the West and performed other tasks in various parts of the country. Although the Army fought many Indian Wars during this period, the engineers were seldom involved.

The Civil War

Thirteen years after the Mexican War, the Civil War erupted. For Civil War service, the War Department increased the number of regular Army engineer troops to four companies, constituting one battalion. This battalion, along with the various volunteer engineer and pioneer units, cleared obstacles; constructed roads, bridges, palisades, stockades, canals, blockhouses, signal towers and in one instance, a church; laid down hundreds of ponton bridges; and erected field fortifications, augmenting them with entanglements. Often, these units accomplished their work under extremely adverse conditions. At Fredericksburg, Virginia, in December 1862, they laid six ponton bridges across the Rappahannock River under devastating fire from Confederate sharpshooters. In June 1864, Army of the

Ponton bridge

Historical Division, Corps of Engineers

Parrott guns in Number 1 Battery near Yorktown, May 1862.

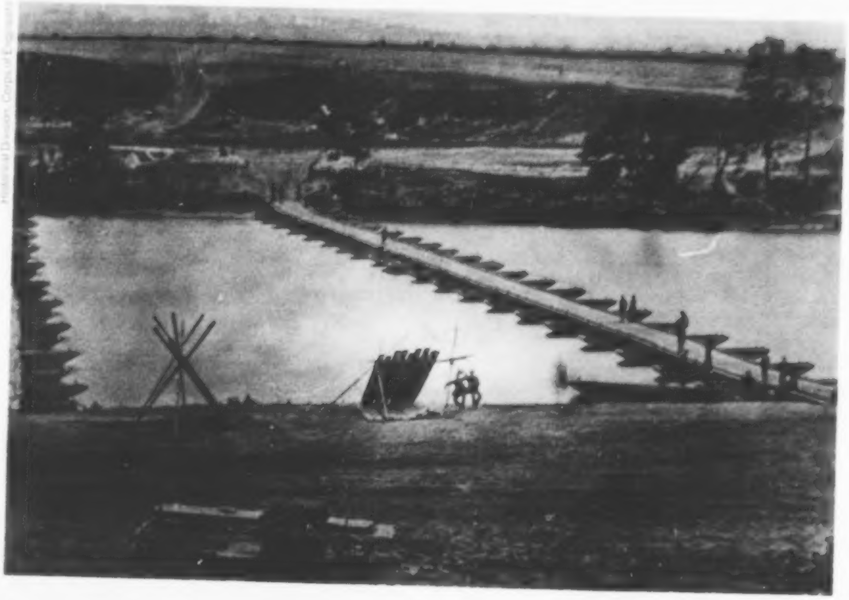
Potomac engineer troops constructed a 2,170-foot ponton bridge across the James River, the longest floating bridge ever until February 1945.

When the Civil War began, two engineer corps existed in the Union Army, the Topographical Engineers and the Engineers. But the exigencies of the war required stricter coordination of engineer activities. Therefore in 1863, the War Department integrated the smaller Corps of Topographical Engineers into the Corps of Engineers under the command of the Chief of Engineers. The title changed to Chief of Engineers in 1866.

The Union Engineers could not benefit from the talents of McClellan, Halleck, George G. Meade, William S. Rosecrans, William B. Franklin, Gouverneur K. Warren, James B. McPherson and Andrew A. Humphreys, who all became general officers commanding combined troops. Likewise, Montgomery C. Meigs was the quartermaster general of the Union Army and furnished the required support and supplies to the troops in the field. By the end of the war, James H. Wilson was a cavalry general.

Other able officers though, like Henry Brewerton, John G. Barnard and Nathaniel Michler, were engineers throughout the war. These men conducted surveys and reconnaissances to provide useful intelligence reports and maps; directed siege operations; and oversaw the operations of engineer troops. Three young engineer lieutenants, William H. H. Benyaurd, John M. Wilson and George L. Gillespie, received Congressional Medals of Honor for gallantry under fire and the latter two concluded their Army careers as Chief of Engineers. Competent volunteer engineer officers like William G. Margedant, who developed a process for duplicating maps in the field, also greatly aided the Union war effort.

The Confederacy gladly accepted the services of 15 engineer officers who resigned their commissions in the U.S. Army. Former engineer officers, such as Lee, Beauregard and Joseph E. Johnston, became Confederate army commanders. Edward P. Alexander was the Confederate artillery commander in the Army of Northern Virginia. To accomplish the necessary engineer work, the Confederacy commissioned many former civilians and raised engineer and pioneer units.



Historical Division, Corps of Engineers

Ponton bridge across the Rappahannock River, built by the 50th and 15th New York Engineers, 1863.

Historical Division, Corps of Engineers

U.S. Army engineers building a military railroad, 1862.

U.S. Military Academy Library

Remodeled Confederate fort, part of federal line of defenses for Atlanta, November 1864.

U.S. Military Academy Library

Troops at Fort Wagner bombproof.

Barnard Collection of Civil War Photos

Etowah Bridge, Georgia, built in two days under the direction of Colonel W.W. Wright.

The Use of Civil Experience in Wartime: Gouverneur K. Warren at Gettysburg

By the summer of 1863, Major General Gouverneur K. Warren, United States Volunteers, had developed a keen eye for terrain. As a Topographical Engineer during the 1850s, Warren had led three exploring expeditions into Nebraska and the Dakotas. In addition he had produced the first comprehensive map of the trans-Mississippi West, an accomplishment that has brought him wide and deserved acclaim.

This talent for assessing terrain, nurtured in civil assignments before the secession crisis, stood Warren in good stead during the Civil War. On the second day of the battle of Gettysburg, Warren saw that the hill called Little Round Top on the southern flank of the Union line was weakly defended. Right away he knew that a strong Confederate attack on the hill menaced the entire Army. To the west, on Seminary Ridge, Confederate General John B. Hood reached the same conclusion and sent a force to take the hill. When Hood's men arrived they found strong Union reinforcements already in place. After a sharp fight, the Confederates withdrew. Warren had beaten them to the hill and saved the day for the Union.

Historical Division, Corps of Engineers

Students at Willets Point building a ponton bridge, 1889.

Post-Civil War Period

After the Civil War and until the outbreak of the Spanish American War, engineer combat experience was minimal. Most engineer officers returned to civil works or fortification construction duty. Nevertheless, engineers attempted to stay abreast of new military engineering methods and innovations.

Soon after the Civil War ended, Congress abolished the Corps of Engineers' supervision of the U.S. Military Academy at West Point, New York. Therefore the Corps, unofficially at first, established an Engineer School at Fort Totten, Willets Point, New York Harbor, in 1866. The school's staff instructed the students, both officers and enlisted men, in civil and military engineering and provided practical training in mapping, military photography and laying submarine mines and bridges, both ponton and trestle. Besides teaching, the staff, especially Henry L. Abbot, who was the superintendent, experimented with and developed new equipment.

Some officers did serve with the "Indian-fighting army" on the western frontier. A few, like William Ludlow, accompanied the troops on reconnaissances and scouting expeditions. Generally though, these officers' main duties were surveying and mapping.

Other officers such as Barton S. Alexander, Cyrus B. Comstock, Peter S. Michie, John M. Wilson, William Craighill, William E. Merrill and William Ludlow travelled abroad, sometimes as military attaches. Often, they had the chance to observe foreign engineer troops, equipment and techniques. A few, including Francis V. Greene, actually witnessed engineer operations in battle.

The War Department created a fifth regular army company of engineers in December 1865. Between the Civil War and the Spanish American War the five companies of the battalion, usually understrength, performed various duties from serving at engineer depots in New York Harbor, St. Louis and San Francisco to riot control during the 1877 railroad strikes. Individual engineer soldiers assisted at numerous civil works and fortification sites throughout the country.

In the trenches, the Philippines, 1899.

We Don't Surrender Much!

At the end of 1862 Colonel William D. Innes and 391 men of the First Michigan Engineers were repairing roads and railroads at the rear of the Union Army near Murfreesboro (Stone's River), Tennessee, when a Confederate cavalry division commanded by General Joseph Wheeler flanked the Union Army to strike hard at supply trains on the way from Nashville to Stone's River. The surprise attack left Innes and the engineers without time to escape the gray-clad troopers, and Innes rushed his unit up a nearby hill.

From the top of the hill Innes could see the advancing Confederate columns and realized he had no time to entrench his position. But the hill was covered with clumps of red cedar trees and Innes quickly decided to use the resource. He sent the engineers scrambling around the hill slashing down the small trees to open a field of fire and piling the cedars in a waist-high circle around the crest of the hill.

Confederates in greatly superior force soon surrounded the hill. An officer under a flag of truce advanced to demand surrender from the engineer detachment and was surprised by Innes's acerbic reply. "Tell General Wheeler I'll see him damned first." Innes continued, "We don't surrender much. Let him take us."

Confederate cavalry soldiers swept up the hill toward the position, but a volley of union fire hurled them back pell-mell. The Confederates then unlimbered field artillery and began pounding the hill, but the engineers scraped shallow foxholes and held their place. A second cavalry assault followed and then a third. In all the cavalry made seven attempts to take the hill, yet the engineers stood their ground until the Confederates concluded the effort was not worth the cost. The engineers suffered 11 casualties; the Confederates nearly 50.

Civil War signal tower, 1864.

Historical Division, Corps of Engineers

Guards at trenches dug by engineers, Guantanamo, Cuba.

Historical Division, Corps of Engineers

The Spanish-American War and Philippine Insurrection

In 1898 the United States went to war with Spain and the engineers provided extensive combat support. In the far-flung theaters of the war from Cuba and Puerto Rico to the Philippines, the engineers aided the Army by erecting landing piers, constructing bridges, building and maintaining roads and repairing and operating railroads. Young but capable lieutenants, like Lytle Brown, Eben E. Winslow and William D. Connor, led engineer detachments on dangerous reconnaissance missions, sometimes in the midst of combat. Volunteer engineer units, often commanded by regular army officers, also served in the war. Former engineer officers, such as Francis V. Greene and William Ludlow, were brigade and higher unit commanders.

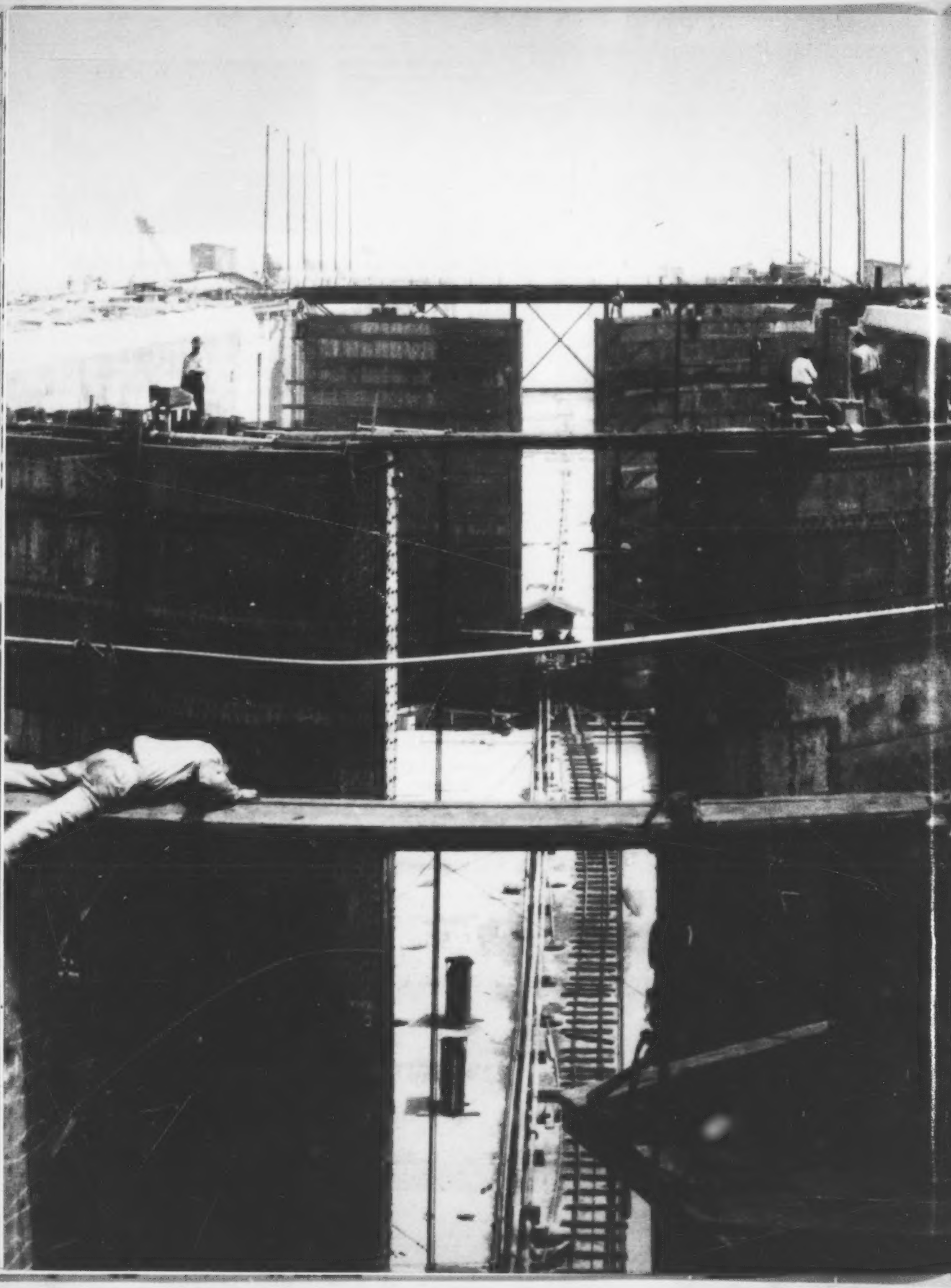
Following the Spanish-American War, an insurrection broke out in the Philippines. Companies A and B of the Engineer Battalion served in the initial stages of the conflict. The insurrectionists' guerrilla warfare tactics necessitated rapid Army movements. Thus, engineer detachments, commanded by William Sibert, John Biddle, John C. Oakes and Harley B. Ferguson, among others, had to repair roads, build bridges and perform reconnaissance rapidly over difficult jungle and mountain terrain. Frequently the engineer troops, who carried rifles as well as picks and axes, joined the infantry in fighting off an attack before completing work on a road or bridge. The requirements of combat, especially in the Philippines, influenced the 1901 reorganization of the engineers into three battalions of four companies each. Although the fighting subsided in the Philippines in the early 20th century, it did not cease, and engineer troops served in the islands, often in combat, for many years afterwards.

The Mexican Punitive Expedition

In 1916 the Corps of Engineers formed three regiments of six companies each from the battalions. In the same year, the United States launched a punitive expedition to Mexico to chastise the "bandits" under Pancho Villa who had raided American Territory. The use of cars and supply trucks required better roads and bridges than ever before. Lytle Brown, now a major, was only one of many engineer officers who served in Mexico. Most likely, these officers were thankful for the experience which was put to the test after April 1917, when the United States entered World War I.

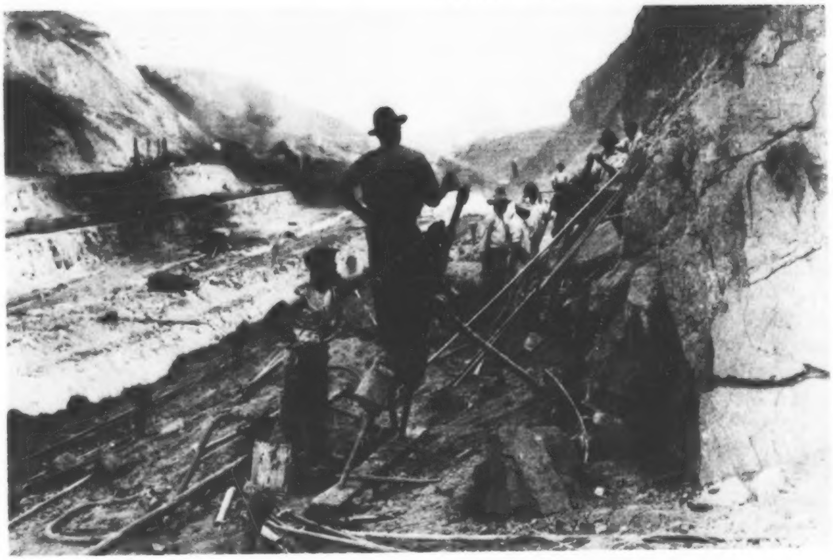
Historical Division, Corps of Engineers

Postcard showing troops near the Mexican border.



The Panama Canal

Drilling on Contractor's Hill
at Culebra Cut, January 1912.



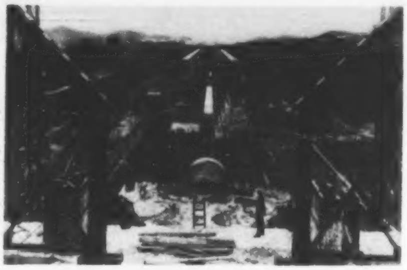
Culebra Cut.

Goethals Collection,
U.S. Military Academy Library

In the early morning of May 4, 1904, a young second lieutenant crisply walked into the old French hotel in Panama City. He exchanged brief greetings with officials of the New French Panama Canal Company. The company, which had succeeded Ferdinand de Lesseps' bankrupt enterprise in 1894, had been no more successful than its predecessor in its effort to build a canal across the Isthmus of Panama connecting the Pacific and Atlantic oceans. Its workers ravaged by malaria, its equipment in a state of disrepair, the company was ready to sell all of its assets to the United States government for $40 million. The lieutenant carefully read the document of transfer. Then, following the directions of the American secretary of war, he signed his name to the receipt: "Marke Brooke, 2nd Lieutenant, Corps of Engineers." The French effort was over. The American attempt was about to begin.

Building the Panama Canal required the assistance of the foremost engineers of the day. Major William M. Black, who later became Chief of Engineers, supervised early engineering activities at the canal. John F. Wallace, first civilian chief engineer on the project, brought railroad construction and operations expertise to the Isthmus. His successor, John F. Stevens, continued his endeavors and established the basic plan for the construction of the canal. He resigned, however, in 1907 when he was severely criticized in the United States. Frustrated by his inability to find someone willing to see the project through to completion, President Theodore Roosevelt turned for help to the Corps of Engineers. "We can't build the Canal with a new chief engineer every year," he said. "Now I'm going to give it to the Army and to someone who can't quit." He requested the Panama Canal Commission to appoint Engineer officer Lieutenant Colonel George W. Goethals as chief engineer and commission chairman. Engineer officers Major William L. Sibert and Major David D. Gaillard, both West Point graduates like Goethals, also served on the commission. All three men received promotions during the time they worked on the canal.

West chamber of Gatun
Upper Locks, March 1912.



Goethals Collection, U.S. Military Academy Library

Pedro Miguel Locks under construction, January 1911.

Historical Division, Corps of Engineers

Work in progress.

Within a year Goethals reorganized canal operations into three geographical divisions. Sibert took charge of the Atlantic Division, and Gaillard took the Central Division. To head the Pacific Division, Goethals selected Sydney B. Williamson, a civilian engineer who had won his respect when the two had worked together earlier at Muscle Shoals. The civilian engineers under Williamson engaged in a spirited competition with the military engineers. Goethals encouraged this competition to achieve maximum economy while speeding construction. Rear Admiral Harry H. Rousseau, Chief of the Bureau of Yards and Docks of the Navy, assumed responsibility for the design and construction of terminals, wharves, docks, warehouses, machine shops and coaling stations. Civilian engineer Ralph Budd directed the relocation of the Panama Railroad from 1907 until 1909, when he was succeeded by Lieutenant Frederick Mears of the Corps of Engineers.

In the 1880s the French had learned after several years of effort that a sea-level canal across Panama was an impossibility. Locks were absolutely necessary. Benefitting from French mistakes, Americans never seriously considered anything other than a canal utilizing locks. They erected a monumental dam across the Chagres River, thereby creating Lake Gatun. At each end of the lake, the engineers constructed locks. The Gatun Locks lead to the Atlantic. The Pedro Miguel Locks lead to Miraflores Lake and, farther on, Miraflores Locks. From these locks ships travel on to the Pacific.

Major Gaillard directed the huge engineering task of completing the Culebra Cut through the continental divide, which required the excavation of 96 million cubic yards of rock and dirt. Spectacular landslides at the Cut were the greatest engineering difficulty. The amount

Goethals Collection, U.S. Military Academy Library

Miraflores Lower Locks, August 1912.

U.S. Aircraft Carrier *Saratoga* in Gaillard Cut, February 1928.

Historical Division, Corps of Engineers

of earth that had to be removed was nearly double the original estimate. More than 100 steam shovels removed most of the soil, and flatcars hauled it out. Trains departed at 13-minute intervals to keep pace with the steam shovels.

Construction of the Panama Canal was never the responsibility of the Army Corps of Engineers, but having engineer officers supervising the project enabled problems to be resolved easier than before, if not always to everyone's satisfaction. For instance, in 1910 President William Howard Taft dispatched Brigadier General William L. Marshall, then Chief of Engineers, to the Canal Zone when a disagreement arose between Goethals and Sibert over the design for the floor of the upper lock at Gatun. Sibert insisted on a gravity section to resist the upward pressure of the full Gatun Lake level, which would act as a lifting force whenever the upper chamber was unwatered. He also wanted to anchor the floor to foundation rock with bent steel rails left by the French. Goethals believed this an extravagant double precaution. He had promised to construct the canal within cost estimates and was unwilling to authorize the additional work Sibert desired.

While not criticizing Goethals' concern for staying within the budget, Marshall decided that Sibert was right. He recommended to President Taft that the double safety factor be adopted. To make sure that Goethals understood he meant what he said, Marshall told him, "I'm going to advise Mr. Taft to keep you both where you are BUT if you can't get along together, I'm going to advise his keeping Sibert here and ordering you elsewhere." This apparently cleared the air, and the two engineer officers worked together to complete the canal within estimates.

Goethals Collection, U.S. Military Academy Library

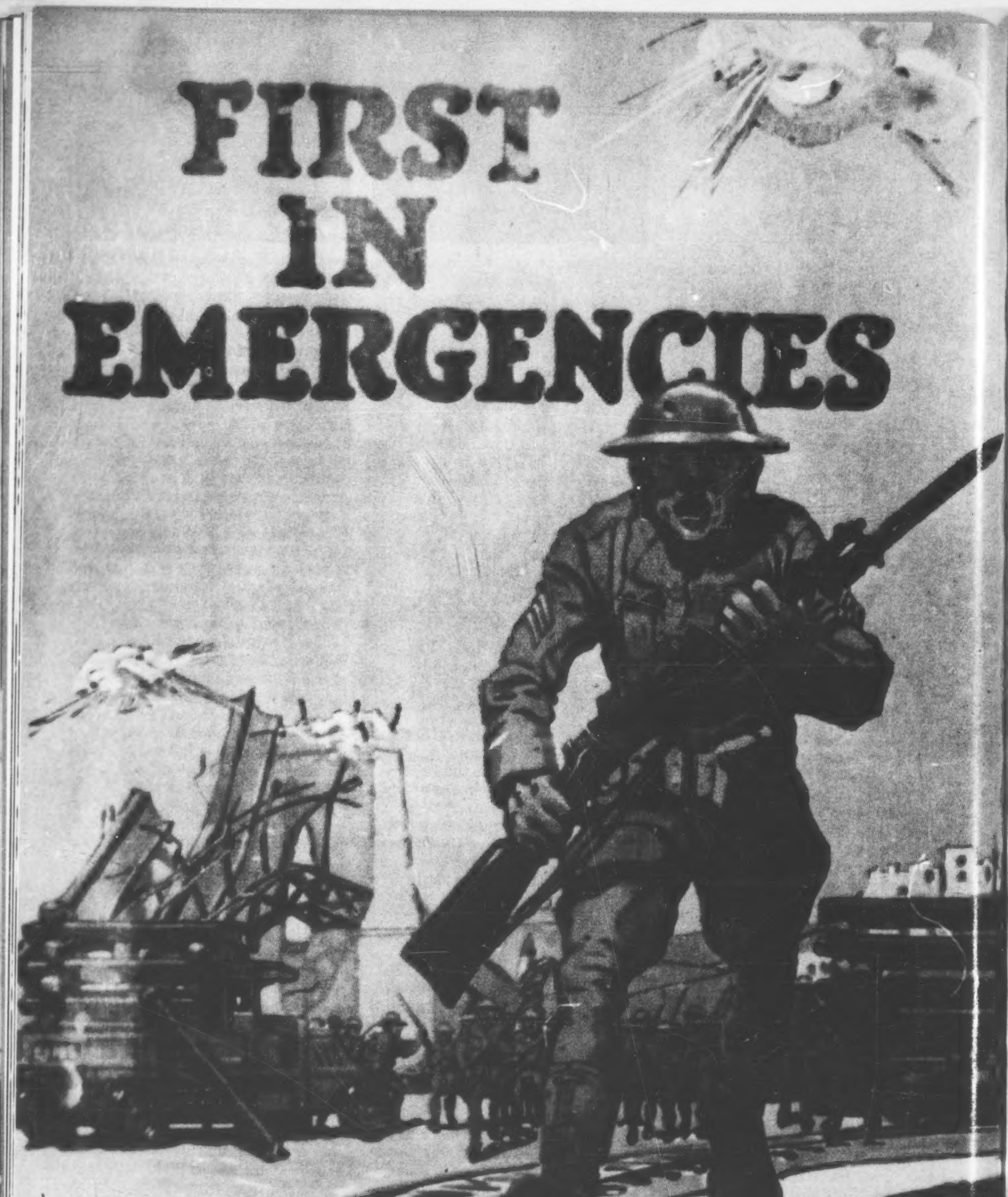
S.S. *Cristobal* in Gatun Upper Locks, August 3, 1914.

The Panama Canal opened ahead of schedule on August 15, 1914. The total excavation for the channel exceeded 200 million cubic yards, of which almost half was taken from the Culebra Cut, later renamed Gaillard Cut in honor of the officer who conquered it, but who tragically died of a brain tumor in 1913 without seeing the canal's completion.

Army engineers retained a unique relationship with the Panama Canal after the canal was opened. Engineer officers traditionally served as the Governor and Lieutenant Governor of the Panama Canal Zone. The Governor also served as President of the Panama Canal Company, which was actually responsible for canal operations.

In the years immediately after the canal's completion, the Corps of Engineers accepted the responsibility for dredging the channel, which continued frequently to be blocked by landslides. Engineers finally determined the proper incline for the banks that provide the greatest insurance against slides. In the 1920s, the Corps further strengthened the banks by developing a system of drainage control. Still later, Army engineers helped enlarge the canal, although the original locks are still in use. One of the most unusual ways Army engineers assisted canal operations occurred in 1968, when the Corps sent the *Sturgis*, the world's first floating nuclear power plant, to the Canal Zone in order to alleviate dangerous reductions of electrical power caused by necessary curtailment of operations at the Gatun Hydroelectric Station. The weather had been so dry that there was not enough water to operate the locks as well as supply the turbines. The 10-megawatt floating station fulfilled a critical need, helping save over one trillion gallons of water for lock operations that otherwise would have been used for electrical generation.

Engineer officers have also periodically assisted in studies on other canal routes across Central America. Army engineers conducted a survey for a route across Nicaragua in the 1930s. In the 1960s, they were heavily involved in studies on an alternate Panamanian route that would accommodate larger vessels. Such an alternative is once more being discussed in the 1980s. Meanwhile, engineer officers still are assisting in the operation of the Panama Canal, continuing a long and proud association.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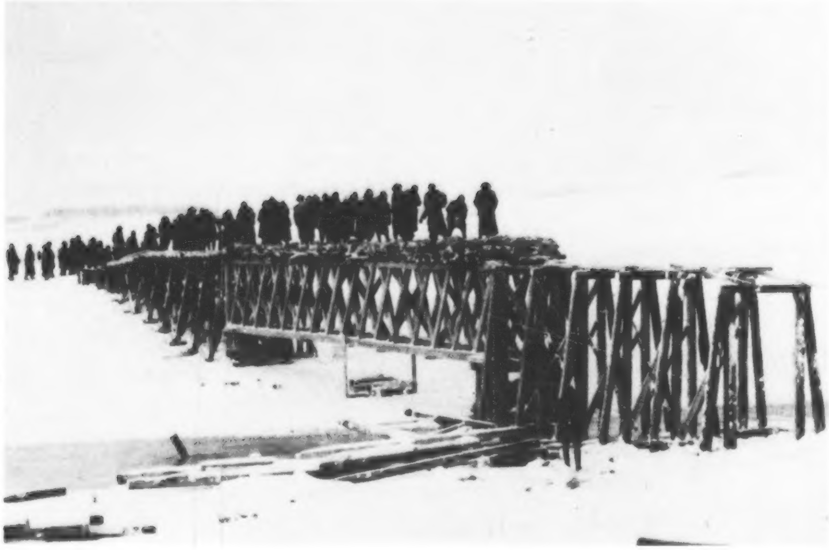
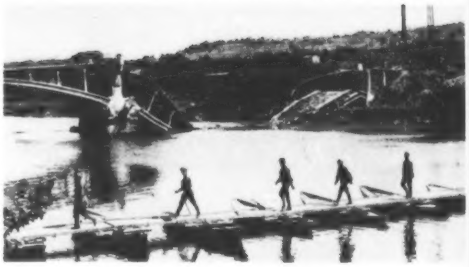
U.S. Army Engineers in World War I

1st Engineers, 1st Division, test a bridge in Gondrecourt, France, January 1918.



Historical Division, Corps of Engineers

First ponton bridge across the Marne River, July 20, 1918.



Historical Division, Corps of Engineers

Company E, 21st Engineers, operates a train near Manil-La-Tour, Toul sector, France, March 1918.

Historical Division, Corps of Engineers

National Archives

World War I recruiting poster.

The Army Corps of Engineers was called upon during World War I to provide a much more diverse range of military services than had ever before been required. Not only did the engineers provide American combat divisions with the officers and men to staff the large 1,660-man engineer regiments that were part of each Army combat division, but they also built the port facilities, roads and railroads needed to bring essential war materiel to the front, harvested timber for military construction, employed searchlights in anti-aircraft defense, organized the first U.S. Army tank units and developed chemical warfare munitions and defensive equipment. So important were these last pursuits that in 1918 a separate Tank Corps and a Chemical Warfare Service were created in the Army, the latter headed by an engineer officer.

The U.S. Army engineers who served in World War I brought with them varied amounts of experience with the military. Most senior engineer officers were graduates of the U.S. Military Academy and had previously served with U.S. Army units abroad, primarily in Cuba or the Philippines. A few of them had accompanied General John Pershing in his expedition to Northern Mexico in 1916-17 that had unsuccessfully attempted to punish the Mexican revolutionary Pancho Villa after his raid on Columbus, New Mexico. Some engineer commanders had been civilian engineers who were members of National Guard or Officers' Reserve Corps Engineer units organized a few years before the United States' entry into the war. But most of the 174,000 engineer troops who served in Europe prior to the Armistice had no prior record of military service.

The British and French governments made the arrival of American engineers in France their top priority after the United States declared war on April 6, 1917. Thus, by the end of August 1917, nine newly organized engineer railway regiments, together with the engineer regiment of the 1st Division, had crossed the Atlantic and arrived in France. Several of the railway regiments were assigned to British or French military formations pending the arrival of larger numbers of American com-

Historical Division, Corps of Engineers

Dugout entrance, Argonne, 1918.

bat troops in the summer and autumn of 1918. It was while serving with the British near the village of Gouzeaucourt, southwest of Cambrai, France, on September 5, 1917, that Sergeant Matthew Calderwood and Private William Branigan of the 11th Engineers were wounded by artillery fire, thereby becoming the first casualties in any U.S. Army unit serving at the front. When the Germans in late November 1917 launched a counteroffensive to regain territory they had just lost to the British near Cambrai, the men of the 11th Engineers abandoned their railway work and assisted the British to construct new defensive positions which stopped the German advance.

During 1918 U.S. Army engineers served in combat from the Vosges Mountains near the Swiss border north to Oudenaarde, Belgium. One battalion of the 310th Engineers even served in the Murmansk area of Northern Russia in a mission designed to assist Czech troops to rejoin the fighting on the Western front. Most of this combat service consisted of the construction of bridges, roads and narrow gauge (60 cm) railroads at or immediately behind the front, but engineer units also engaged in direct combat. Noteworthy among this combat service was the action of two companies of the 6th Engineers who ceased their construction of heavy steel bridges to join British and Canadian forces in front-line trenches where they together successfully defended Amiens from a heavy German assault in March and April 1918. These two engineer companies suffered a total of 77 casualties. During June and July 1918, troops of the 2d Engineers fought as infantry in their division's bitterly contested capture of the Belleau Woods and the nearby village of Vaux in the Aisne-Marne campaign. A battalion of the 1st Engineers fought as infantry in the capture of Hill 269 in the Romagne Heights along the Hindenburg Line on October 8, 1918. It was for his action during this fighting that engineer Sergeant Wilbur E. Colyer of South Ozone, New York, was awarded the Medal of Honor. Colyer volunteered to locate a group of German machine-gun nests that was blocking the American advance. He used a captured German grenade to kill one enemy machine-gunner, turned his machine gun against the other enemy nests, and silenced each of them.

Historical Division, Corps of Engineers

170th Engineers build a bridge in Cierges, France, August 1918.

Other U.S. Army engineers won personal recognition for their actions in bridging the Meuse River. Major William Hoge, Jr., a West Pointer serving with the 7th Engineers, 5th Division, won a Distinguished Service Cross for his heroism in reconnoitering a site for a ponton bridge across that well-defended waterway north of Brieulles, France. Hoge selected the bridge site during the daylight hours of November 4, 1918, while under enemy observation and artillery fire and he directed the construction of the bridge that night. After German artillerists destroyed three ponton boats supporting the bridge, engineer Sergeant Eugene Walker, Corporal Robert Crawford and Privates Noah Gump, John Hoggle and Stanley Murnane jumped into the icy river and held up the deck of the bridge until replacement pontons could be launched and installed. These enlisted men were also awarded the Distinguished Service Cross. This

French officers train American troops.

Company D, 11th Engineers, builds a road near the Meuse.

National Archives

bridge was one of 38 constructed by the Corps of Engineers during the critical Meuse-Argonne offensive, which ended with the German military collapse.

U.S. Army engineers also made essential contributions to ultimate victory well behind the front lines. The forestry troops of the 20th Engineers, the U.S. Army's largest regiment, produced roughly 200 million feet of lumber in France, together with some three million standard gauge railroad ties and one million narrow gauge ties. American troops, under the technical supervision of Army engineers, used this lumber in the construction of new and expanded port facilities for American ships, including berths for deep-draft vessels at Brest that were the only ones available to U.S. vessels; storage depots containing more than 20 million square feet of covered storage space; new hospitals containing more than 100,000 beds; and barracks capable of housing 742,000 men. Engineer troops constructed 800 miles of standard-gauge rail lines, together with an equal distance in yards and storage tracks; water supply facilities at several French ports and communications centers; and 90 miles of new roads. During the war U.S. Army engineers drew and printed maps, conducted geological studies with an eye to underground water supplies, installed and operated electrical lines and mechanical equipment, and experimented with the use of tractors and trailers for hauling ponton bridging equipment in the absence of sufficient animals. American engineers also operated seven cement plants in France. These varied facilities permitted the U.S. Army to field and support a force of nearly two million men in France within 20 months of the nation's entry into the war.

Maintaining High Standards: The 2d Engineers in France, 1918

During World War I, the 2d Engineer Regiment of the 2d "Indian Head" Infantry Division, commanded by Colonel William A. Mitchell and then James F. McIndoe, was considered one of the best regiments in the American Expeditionary Forces (AEF) in France. Because of its bloody engagements at Belleau Woods, Chateau Thierry, Soissons and Meuse-Argonne, the division's infantry units sustained the highest percentage of major casualties to its strength among all AEF units – its 30.38 percent casualty rate just edging the 30.08 percent of the "Big Red 1," 1st Infantry Division. The 2d Engineers, moreover, stood 15th in the list of casualties with 12.73 percent, by far the highest of any engineer unit. The reasons were simple – the trench war was preeminently an engineer's war, cutting barbed wire entanglements, putting them up, digging dugouts, machine gun positions and trenches and all too often fighting as infantry.

Throughout its time in combat the regiment maintained high morale and unexcelled performance in all its assignments. An unnamed American general officer said that "the 2d Engineers is the best regiment I ever saw . . . The regiment has assisted the artillery, has helped the tanks, built railroads, manned machine guns and fought time after time as infantry. That regiment can do anything." One reason for its excellent performance was the high standards its officers and men required of themselves and each other. These standards applied throughout the regiment and were vigorously enforced.

U.S. Army tractor negotiates a steep grade on the Rhine at Coblenz, Germany.

U.S. Military Academy Library

Combat Engineers in World War II

Amphibious engineers put assault troops ashore on Wadke Island, New Guinea, May 18, 1944

Historical Division, Corps of Engineers

167th Engineer Combat Battalion, 1117th Engineer Group, builds the first Bailey bridge across the Rhine at Wesel, Germany, March 26, 1945

Half-tracks cross the Seine on a ponton bridge, August 1944

As Japanese forces pressed their attacks in China and Hitler increased his territorial demands in Central Europe in mid-1939, the U.S. Army Corps of Engineers numbered less than 800 officers and 6,000 enlisted men in active Regular Army service. During the preceding 17 years, since the withdrawal in 1922 of engineer troops from Coblenz, Germany, where they had occupied territory along the Rhine River, the Army had maintained in active service only eight or nine combat engineer regiments, two engineer squadrons and a single topographic battalion. It staffed even this short troop list at only some 70 percent of authorized strength. Engineer officers thus spent most of their time during the 1920s and 1930s administering the Corps' civil works program, whose budget in 1938 was nearly 400 times greater than its military budget.

Engineer military mobilization began in earnest in mid-1940 after the German conquest of France. During late 1940 and early 1941 the Army inducted 18 National Guard divisions, each containing an engineer combat regiment, and their men began to undergo intensive training. The Army quickly organized engineer aviation companies and battalions to build the airfields needed to defend the Western Hemisphere. Blacks joined the Army in unprecedented numbers in 1940 and 1941, and many were assigned to engineer units. Black soldiers, who numbered 20 percent of Corps personnel by the war's end, were assigned to segregated units usually in the construction field, but they sometimes were instructed by officers such as Major (later General) Andrew Goodpaster.

Initiated well before the attack at Pearl Harbor, engineer research and development projects directed by the Engineer Board at Fort Belvoir, Virginia, would have a significant impact upon the war. Experiments conducted during 1940 and 1941 developed a light and inexpensive pierced-steel plank mat that the Army Air Forces would widely use to provide safe, stable landing fields for American planes. Spurred by the ideas of Engineer Captain (later General) Bruce Clarke, Engineer Board studies perfected a new steel treadway bridge constructed on pneumatic floats that would carry heavy modern tanks across the rivers of Europe. And it was the Engineer Board that produced by 1943 a tank dozer capable of knocking over substantial barriers while pursuing an armored assault.

When the Japanese bombed Hawaii and the Philippines on December 7, 1941, engineer units that had already been deployed to those islands were called upon to respond. The 34th Engineers, a combat regiment which had lost some equipment but no casualties during the bombing in Hawaii, worked to maintain roads that were suffering from heavy military traffic. The skimpy, 1,500-man U.S. Army engineer garrison in the Philippines was almost evenly divided between Filipino and American personnel. After destroying bridges from one end of Luzon to the other to slow the Japanese advance, these engineers erected a series of defensive lines on the Bataan Peninsula and fought as infantry in these defenses before succumbing to superior Japanese forces in April and May 1942. In the southern Philippines, a number of Army engineers escaped to the mountains of Mindanao, where they worked with Filipino guerrillas and remained active throughout the period of Japanese occupation of the Philippines.

U.S. Army engineers first entered combat against German and Italian forces in North Africa, where they landed in November 1942. During the first five months of 1943, a few units of American engineers assisted U.S. Army movements in the broad deserts and fields of Tunisia, clearing enemy mines and building roads from scratch. Prior to the American attacks on Gafsa and Maknassy in the barren plains of southern Tunisia, the 1st Engineer Combat Battalion and a company of the 19th Engineer Combat Regiment built combat approach roads through a no-man's land between the combatants, where they were vulnerable to surprise attacks.

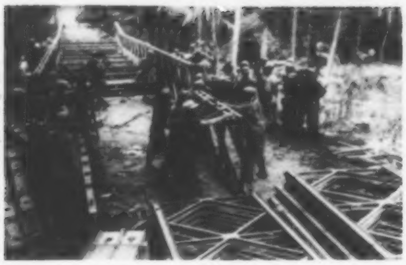
Historical Division, Corps of Engineers

Demolition squad probes for Japanese booby-traps.

After the Allied victory in North Africa, American and British forces landed first in Sicily and then in continental Italy during the summer of 1943. Defended by well-equipped and determined German forces, Italy's mountainous terrain and rapidly flowing rivers challenged the road- and bridge-building skills of the Army engineers. The combat engineers particularly distinguished themselves in the fighting at and just south of the Rapido River in the Army's drive north from Naples. The 48th and 235th Engineer Combat Battalions, assigned to an armored task force under Brigadier General Frank Allen that was ordered to capture Mount Porchia just south of the Rapido, not only removed obstacles and opened supply lines but also fought as infantry on the flanks of the task force's advance. After enemy fire had substantially reduced the armored infantry units leading this attack, the 48th was ordered to

Defense Audio-Visual Agency

1st Battalion, 355th Engineers, clears St. Lo for Omaha Beach traffic.



Historical Division, Corps of Engineers

Working on a Bailey bridge over the Magampon River, Luzon, the Philippines, April 3, 1945.

secure the top and sides of the mountain. It was in this effort that engineer Sergeant Joe Specker of Odessa, Missouri, having observed an enemy machine-gun nest and several well-placed snipers blocking his company's progress, advanced alone with a machine gun up the rocky slope. Although mortally wounded by intense enemy fire, Specker nevertheless set up and fired his weapon so effectively that the enemy machine gun was silenced and the snipers were forced to withdraw. With this assistance the battalion was able to clear the summit of Mount PonoDia. Sergeant Specker was honored by a posthumous award of the Medal of Honor.

More than a dozen U.S. Army Engineer combat battalions landed on the beaches of Normandy during the Allies' assault landing on June 6, 1944. The engineers cleared the beach obstacles and minefields that the Germans had implanted there, absorbing on Omaha Beach substantial casualties including the loss of two battalion commanders. Bulldozer drivers, often working in the face of heavy enemy fire, opened exits up narrow draws through the cliffs lining the beaches. Some of the engineers quickly engaged in combat with the Germans alongside assault infantry teams. In one such action, Lieutenant Robert Ross of the 37th Engineer Combat Battalion took charge of an infantry company that had lost its leaders and led it and his own engineer platoon up the slopes adjoining Omaha Beach, where they killed 40 Germans and captured two machine gun emplacements.

The engineers again provided critical support to the achievement and exploitation of the breakthrough that American forces created in late July 1944 in enemy defenses southwest of St. Lo, France. Army and divisional engineer troops repaired roads and cleared enemy mine fields in and beyond St. Lo with exceptional speed and they rapidly bridged the small rivers in the area to maintain the Americans' momentum. After the German line had been effectively pierced, armored division engineers constructed the treadway bridges needed by Patton's tanks in the Third Army's quick pursuit of the retreating Germans across northern France. Engineer general service regiments behind them rapidly reconstructed or replaced railroad bridges that had been destroyed by the retreating Germans. In Lorraine the 130th Engineer General Service Regiment successfully built under heavy artillery fire a 190-foot-long double-triple Bailey bridge that Third Army troops used to cross the Moselle at Thionville, France. This bridge had to reach 10 feet longer than the specified maximum span of such a bridge, but it successfully carried heavy American tanks.

Connecting sections of 100-foot "snake" torpedo to pulling tank, Gorze, France.

Historical Division, Corps of Engineers

The massive German offensive in the Ardennes forest that began on December 16, 1944, exacted a heavy toll among the sparse American forces surprised in the area. A disproportionate number of those troops were engineers who had been operating sawmills or repairing forest roads and of necessity these engineer troops were called upon to fight as infantry. The 81st Engineer Combat Battalion, which had been engaged in road maintenance around Auw, Germany, quickly found itself caught in the center of the powerful enemy assault, and

When the Germans withdrew from northern France in the summer and fall of 1944, they left Cherbourg harbor a shambles. A massive reconstruction job faced engineers with the American forces who occupied the city. The difficulty of obtaining adequate construction materials from the United States only exacerbated the problem. The situation demanded prompt and ingenious improvisation and the Advance Section (ADSEC) Engineers of the Communications Zone were up to the task.

The enemy had made a big mistake at Cherbourg and the engineers turned it to their advantage. Lieutenant General Emerson C. Itschner (Ret.), then a colonel and ADSEC Engineer, recalled the situation: "The Germans were kind enough to leave us a lot of very heavy steel beams, one meter in depth and up to 75 feet long. We had enough of these to bridge from the piles that we drove back to the seawall."

Exploitation of the mistake did not stop with the reopening of the port of Cherbourg.The ADSEC engineers noted that all of the beams bore the name of a single steel mill, Hadir in Differdange, Luxembourg. Right then Itschner decided they would head for Differdange. So, as soon as the town fell, the ADSEC men were there. They were not disappointed: the Hadir plant was intact and the citizens were eager to reopen it. After a little repair and cannibalization, Hadir began once again to produce meter beams. In a short time these beams were put to many important uses including the construction of the massive railroad bridges across the Rhine.

Thus did engineer alertness and ingenuity solve a major supply problem.

Treadway bridge lowered into place near Moderscheid, Belgium, January 1945.

U.S. Military Academy Library

within a week the Germans had captured or killed a majority of its troops despite their determined combat, notably in the defense of St. Vith, Belgium.

Colonel H. W. Anderson's 1111th Engineer Combat Group was headquartered at Trois Ponts, Belgium, right on the path of Joachim Peiper's fast-moving assault tank group. Despite their inferior numbers, Anderson's engineers put up a stout and effective resistance which crippled Peiper's force. A mine field hastily laid by a squad of the 291st Engineer Combat Battalion before Stavelot delayed Peiper's entry into that town overnight. On the following day, December 18, engineers from that battalion helped deflect the German tank column away from the critical petroleum depot near Francorchamps, located on the road to Spa where the First Army had its headquarters. A company of the 51st Engineer Combat Battalion then diverted the column again at Trois Ponts by blowing the bridges there and defending the village alone until airborne troops could reinforce it. Peiper's tanks eventually ran out of fuel well short of his Meuse River objective, and Peiper's men had to abandon them.

To the south, elements of the 44th, 103d, and 159th Engineer Combat Battalions delayed portions of the German Fifth and Seventh Armies at the villages of Wiltz, Hosingen and Scheidgen in Luxembourg, before German forces overwhelmed their positions. While ultimately unsuccessful, the defense undertaken by these engineer units delayed enemy forces long enough to permit American infantry, airborne and armored units to come to the defense of critically located Bastogne. Engineer troops also fought before Bastogne, some using anti-tank weapons with which they had no experience. Private Bennard Miohin of the 158th Engineer Combat Battalion waited until an enemy tank came within 10 yards of him before having sufficient assurance of his target to fire a bazooka at it. The resulting explosion temporarily blinded him. He rolled into a ditch and, hearing enemy machinegun fire, lobbed a hand grenade toward its source. The firing stopped

U.S. Army Corps of Engineers

Members of 166th Engineers, sanding a highway with mechanical spreader. Near Wiltz, Luxembourg–1945

Telling It Like It Is

Some folks accuse Army engineers of patting themselves on the back. If, at times, they do seem boastful, it may be because they have something to boast about.

At a convention of the American Historical Association in the late 1940s, Dr. O. J. Clinard, then the Corps of Engineers' chief historian, was in a cocktail lounge with friends. After a few drinks, Clinard started extolling the glories of the Corps and was soon reeling off a list of engineer "greats":

Sylvanus Thayer, "father of West Point"

John C. Frémont, "pathfinder of the West"

Gouverneur K. Warren, hero of Gettysburg

George W. Goethals, builder of the Panama Canal

Charles G. Dawes, vice president of the U.S. under Coolidge

Lucius D. Clay, post-war governor of Germany

At that, a friend broke in: "Hold on, old buddy. Next you'll be telling us that Robert E. Lee and Douglas MacArthur—our greatest soldiers—were Army engineers."

Clinard beamed.

"Go look 'em up," he said.

Engineers operate infantry assault ferry across the Neckar River in Heilbronn, Germany, April 1945.

Historical Division, Corps of Engineers

Placing explosive charges on concrete tank barriers along the Siegfried Line, October 1944.

Historical Division, Corps of Engineers

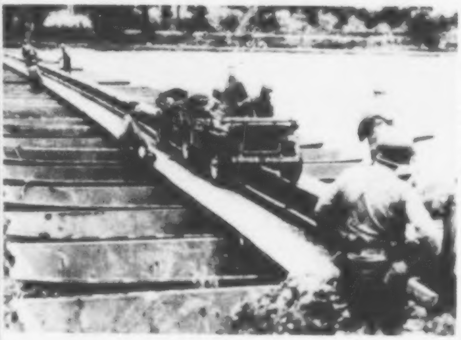
abruptly. Miohin was awarded a Distinguished Service Cross.

After holding Bastogne and St. Vith, American forces pushed a badly weakened German army out of the Ardennes and advanced to the river barriers of the Roer and Rhine. Relying on Army engineer bridging skills, the U.S. Army crossed the Roer on February 23, 1945, before floodwaters released by the breaking of upstream dams had subsided, thus surprising the Germans and permitting a rapid American advance. Engineers also played a critical role in the surprising capture of the Ludendorff railroad bridge across the Rhine at Remagen on March 7. As elements of the armored combat command, under career Engineer officer Brigadier General William M. Hoge, Jr., approached the bridge that afternoon, the Germans set off a charge of dynamite in an unsuccessful attempt to destroy the span. Risking a new explosion, Lieutenant Hugh Mott, Sergeant Eugene Dorland and Sergeant John Reynolds, all members of Company B, 9th Armored Engineer Battalion, ran onto the bridge in the company of assault infantrymen. The engineers first located four 30-pound packages of explosives tied to I-beams under the decking, cut these free and sent them splashing into the Rhine. After the infantry had cleared the far-shore bridge towers, Sergeant Dorland found the master switch for some 500 pounds of intended bridge demolition explosives, and he quickly shot out the heavy wires leading from it. Lieutenant Mott then directed under continuing heavy enemy fire the repair of the bridge's planking and seven hours later he reported that tanks could cross.

While nine U.S. Army divisions crossed the Rhine at Remagen, most U.S. forces crossed that broad river in assaults in late March 1945 that were supported by the combat

Historical Division, Corps of Engineers

"Lincoln on the Hudson" railway bridge across the Rhine at Wesel, Germany, March 30, 1945



Historical Division, Corps of Engineers

First jeep to cross ponton bridge over the Meuse near Houx, Belgium, September 1944

bridge-building endeavors of the Corps of Engineers. Engineer boatmen piloted Navy landing craft to carry assault units across the swift-flowing Rhine. Behind them other engineers began installing numerous heavy ponton and treadway bridges that would securely tie the assaulting troops to their sources of supply. Third Army engineers built a 1,896-foot-long treadway bridge across the Rhine at Mainz under combat conditions. Further south, Seventh Army engineers completed in a scant nine-and-a-quarter hours a 1,047-foot ponton bridge across the Rhine at Worms. Heavy enemy fire delayed completion of some bridges and exacted casualties. Captain Harold Love, commander of an engineer treadway bridge company, was killed when the treadway section he was ferrying to a partially completed bridge at Milohplatz was struck by a German shell. After crossing the Rhine, the Western Allies pushed rapidly across Germany toward their rendezvous with the Russians at the Elbe River. When the Soviet army arrived in Magdeburg in May, they found that Ninth Army engineers had already on April 13 built a treadway bridge across the Elbe at Barby 15 miles south of that east German city.

In the fighting against Japanese forces in the Pacific U.S. Army engineers distinguished themselves notably during the amphibious landings that they supported. The engineer boat and shore regiments of the 2d, 3d and 4th Engineer Special Brigades directed a series of landings on the north coast of New Guinea and on nearby New Britain, Los Negros, Biak and Monotai Islands as U.S. and Australian forces advanced by sea in a step-by-step fashion toward their October 1944 return to Leyte Island in the Philippines. The engineer boatmen who brought ashore a task force of the 91st Infantry Division at Nassau Bay, New Guinea, on June 30,

Historical Division, Corps of Engineers

Private Junior N. Van Noy.

1943, found themselves engaged in hand-to-hand combat with a much larger Japanese force assaulting the beaches just one day after the landing. Demonstrating their skill with knife and bayonet, the engineers held their portion of the beach perimeter. After the Allies captured the Japanese base at Finschhafen three months later, U.S. Army shore engineers operating the beach depot two miles north of that New Guinea town were surprised by a Japanese landing attempt before dawn on October 17, 1943. Here engineer gunner Junior Van Noy, a 19-year-old private from Idaho, refused to heed calls to withdraw from his shoreside machine gun position despite heavy enemy attacks on it with grenades, flame throwers and rifle fire. Van Noy managed to expend his entire stock of ammunition on the fast-approaching Japanese before succumbing to enemy fire. He is thought to have alone killed at least half of the 39 enemy troops that had disembarked. Van Noy was honored with a posthumous award of the Medal of Honor.

Engineer combat forces also participated in maneuver warfare on land against the Japanese. On May 29-30, 1943, the Japanese that had been surrounded by U.S. Army forces on Attu Island in the Aleutians attempted to break through the portion of the American lines held by an engineer combat company, but they were decisively repulsed. The unit killed 53 of the enemy while having only one officer killed and one enlisted man wounded in the battle. In the Philippines, the 302d Engineer Combat Battalion, responsible for road maintenance across rice paddies and swamps near Ormoc on Leyte, built or reinforced 52 bridges for tank traffic in mid-December 1944, generally working under small-arms and mortar fire, and contributed men and armored bulldozers to flush enemy troops out of their foxholes in the bamboo thicket. In northern Luzon and on Mindanao in the Philippines in early 1945 divisional engineer battalions completed essential road and bridge-building projects in difficult mountainous terrain that sometimes rose higher than 4,000 feet above sea level. The 106th Engineer Combat Battalion on Mindanao constructed a 425-foot infantry support bridge across the Pulangi River and encountering a gorge 120 feet across and 35 feet deep, blasted out its sides to create in a speedy fashion a crude rock bridge. Much of the engineer construction work on Luzon and Mindanao was also interrupted by enemy fire.

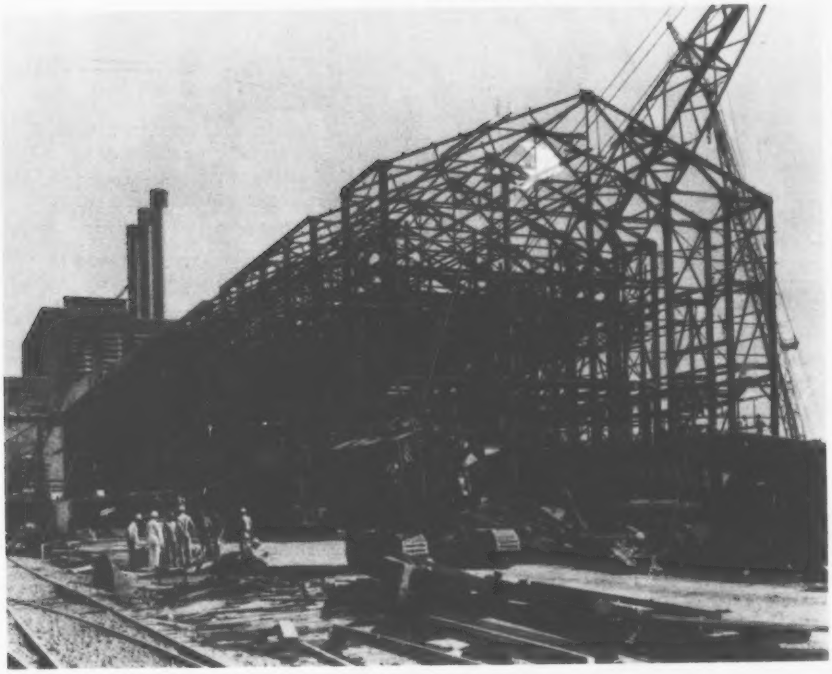
During World War II the U.S. Army Corps of Engineers contributed essential military services wherever the U.S. Army was deployed.

General Dwight D. Eisenhower exhorts paratroopers on D-day, June 6, 1944.

Historical Division, Corps of Engineers

The Manhattan Project

S-50 thermal diffusion plant under construction.



Atomic Energy Commission

The Manhattan Project was the United States' effort to develop an atomic weapon during World War II. In three short years, the project brought atomic weaponry from scientific hypothesis to reality.

Following the discovery of nuclear fission in Germany in 1930, physicists the world over began experimenting to determine if neutrons were released during fission and, if so, how they might be utilized to create a chain reaction. If controlled in a reactor, such a chain reaction would be a great power source. If uncontrolled, it could produce an explosion far greater than any from chemical explosives.

The initial effort to hasten the progress of atomic research in the United States came from the scientific community. A small group of European scientists had settled in the United States after fleeing from Nazism in the late thirties. They were well aware of the atomic research being done in Germany and fearing that Germany would produce an atomic bomb first, they prevailed upon Albert Einstein to persuade President Roosevelt to increase funding for atomic research and development.

After America's entry into the war in December 1941, researchers from the Allied nations joined the effort. The Allies drew up formal agreements on atomic cooperation and a scientific military intelligence unit was established to follow German progress in atomic research.

Hanford plant.

Public Affairs Office, Corps of Engineers

General Groves recognizes Oppenheimer.

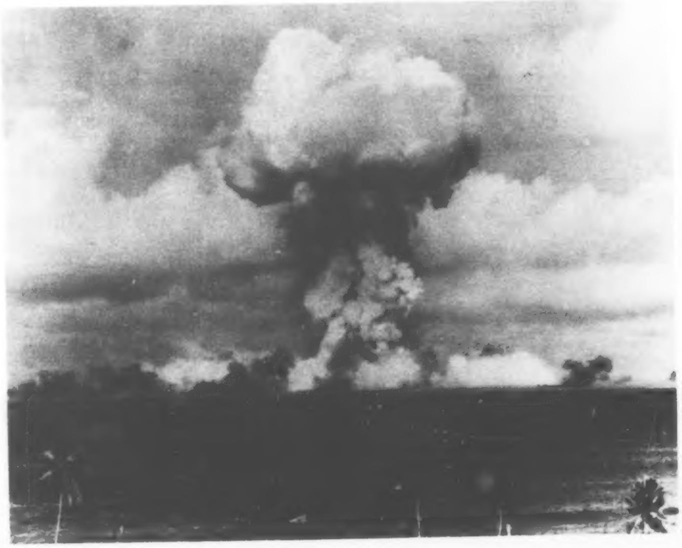
Public Affairs Office, Corps of Engineers

By the spring of 1942, research had progressed to the point that an atomic weapon actually seemed possible. The National Defense Research Committee, then coordinating atomic research and headed by Vannevar Bush, began to formulate plans for the construction of production facilities. The U.S. Army Corps of Engineers, designated by the Committee to oversee the program, provided the technical expertise required for this mammoth construction project.

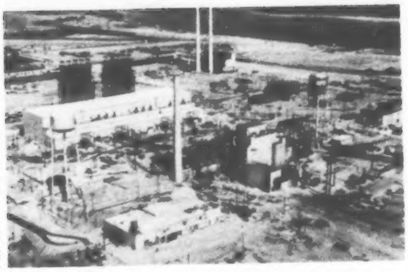
On June 18, 1942, Major General W. D. Styer, Chief of Staff for Army Services of Supply, directed Colonel James C. Marshall of the Corps of Engineers to form a new engineer district. The district was to carry out the Corps' new responsibility for construction for the project.

The new district's offices were initially located in Manhattan at the headquarters of the Corps' New York District. The name "Manhattan" stuck. It seemed to be a name

Mushroom cloud from test detonation on Bikini Atoll, July 1, 1946.



Joint Task Force 1, U.S. Army



Public Affairs Office, Corps of Engineers

First pile area at Hanford Works.

that would arouse the least suspicion, for the district, the project and its super-secret mission.

By September, Major General Leslie R. Groves, formerly Deputy Chief of Construction in the Corps, had been named by Secretary of War Stimson to direct the entire project. Scientific direction remained with the National Defense Research Committee within the Office of Scientific Research and Development that Vannevar Bush headed.

As research continued in the fall of 1942, Groves and Marshall began to select sites for the atomic material production plants. The sites all had to be isolated so they could be sealed off for tight security. They all needed great quantities of both water and electricity. An additional site also had to be found at which scientists could finally assemble the weapons.

At the recommendation of Groves and Marshall, the government purchased 83,000 acres of land near Clinton, Tennessee, for the Clinton Engineer Works (later called Oak Ridge). Here the Corps built uranium separation plants to separate the fissionable isotope Uranium-235 from the isotope more prevalent in uranium ore, Uranium-238. Army engineers also constructed residential communities to house employees.

In December 1942, when Enrico Fermi produced a controlled chain reaction at the University of Chicago, he discovered a new material suitable for fission. He found that during the chain reaction Uranium-238 could capture neutrons and be transformed into plutonium, a new element as unstable as Uranium-235. Twelve days after Fermi's successful experiment, Groves discussed building a plutonium plant site with scientists and industry and Corps representatives. The government soon purchased almost a half million acres around Hanford, Washington, near Bonneville Dam for the construction of five plutonium reactors and employee housing.

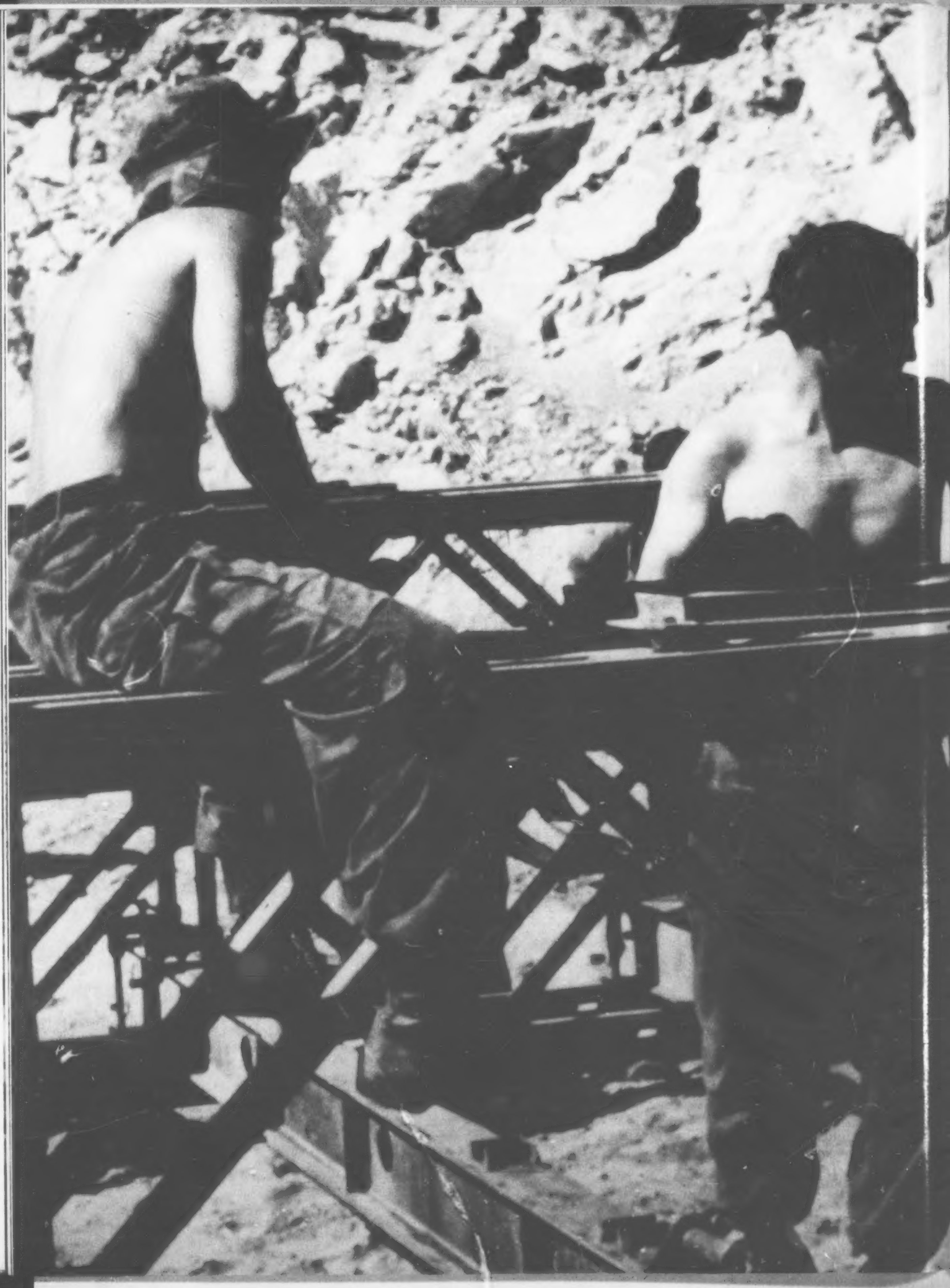
Besides building huge industrial plants and providing the most basic community needs of water, roads, sanitation, housing and power, the Corps also managed the construction of scientific equipment, newly designed and as yet untried. At both Hanford and Oak Ridge the project requirements were initially underestimated. At Oak Ridge alone the cost of the land was $4 million. Construction costs at Oak Ridge by December 31, 1946, totalled $304 million. Research at this site eventually totalled $20 million, engineering $6 million, and operation $204 million. Power for operation alone cost $10 million. Instead of requiring a work force of 2,500 people as was originally planned, Oak Ridge eventually had 24,000 employees on the payroll.

As work continued at Oak Ridge and Hanford, General Groves appointed J. Robert Oppenheimer to take charge of the newly created weapons laboratory in an isolated desert area around Los Alamos, New Mexico. Here scientists assembled the weapons. The first explosion of an atomic bomb occurred here.

The engineering problems encountered in the project were numerous. Groves and his staff fought constantly for needed raw materials. The engineers continually had to translate the scientists' theories into precise specifications. New materials had to be formulated for the building of the reactors and the separation equipment. Contractors were held to extremely exacting specifications for everything they supplied.

The Corps' engineering role required the simultaneous coordination of construction with research and new discoveries. It required the building of huge industrial facilities along with community public works needed to provide a livable environment for the employees. It required the transportation of goods to these isolated areas, the management of huge amounts of money and the coordination of input from hundreds of contractors.

The project also required the maintenance of a delicate relationship between the military and the scientific communities. Workers and scientists had relocated to physically isolated areas and because of the secrecy of their work, had to limit their contact with the outside world. Even in wartime, when the work had a special urgency and sacrifices were made for the war effort, morale was a great concern. The scientists especially were uncomfortable under the military supervision and security restrictions. Very few of the thousands of employees on the project knew what they were actually working on because of the strict security. The employees did share, however, in the anxiety over the unknown dangers inherent in the materials they dealt with. No one dreamed at the beginning how massive the project would become and that its cost by war's end would total $2 billion. Very few realized the tremendous impact the project would have on the world.



Engineer Combat in Korea and Vietnam

Bridging the Hantan River along the central front, April 1951.

Historical Division, Corps of Engineers

Sergeant George Libby

Surveying for a shorter ammunition supply route, December 1951.

Building a Bailey bridge in Vietnam.

Public Affairs Office, Corps of Engineers

The rugged terrain of the Korean peninsula and the numerical superiority of enemy forces there made engineer construction and combat vital to the U.S. Army during the Korean War. Surprised by the North Korean attack across the 38th parallel, U.S. Army troops in Korea and the Republic of Korea's forces could at first do no more than delay the advance of the larger North Korean forces. U.S. Army engineers played a major role in this delaying action, mining roads and destroying key bridges. In this early fighting, engineers were frequently called upon to do tasks not traditionally theirs. Thus it was members of Company C, 3d Engineer Combat Battalion, that on July 20, 1950, made the first verifiable combat use near Taejon of the newly developed 3.5-inch rocket launcher, using it to destroy a tank that was threatening their division commander.

Attempting to withdraw from Taejon that evening, U.S. forces were stopped for a time by enemy roadblocks. Engineer Sergeant George Libby placed wounded men on an artillery tractor and used his body to shield its driver as it crashed through two enemy roadblocks before reaching American lines to the south. Libby, who died of his wounds, was posthumously awarded the Medal of Honor.

After U.S. Army engineers destroyed the bridges over the wide Naktong River in the southeastern corner of Korea on August 2-3,

Engineers prepare to blow a bridge in North Korea, to slow enemy advance, December 1950.

Historical Division, Corps of Engineers

1950, the outnumbered American forces maintained a long defensive perimeter around Fusan as General Douglas MacArthur prepared to land a large body of U.S. troops behind enemy lines at Inchon. Engineers were frequently committed to fight as infantry on the Pusan perimeter. Private Melvin Brown of the 8th Engineer Combat Battalion was awarded the Medal of Honor for bravely holding his position on a wall of the ancient fortress of Kasan during an enemy assault. After he had expended his ammunition, Private Brown used his entrenching tool to repel the armed attackers as they reached the top of the wall.

After MacArthur's assault at Inchon had caught the enemy by surprise, U.S. forces soon took the offensive across Korea. The bridge building and road and rail repairs undertaken by the Army engineers allowed U.S. and allied forces to push north rapidly in pursuit of the disintegrating North Korean army. Handicapped at first by tremendous shortages of supplies, these construction efforts required the engineers to make innovative use of available materials. When Chinese units began their powerful counteroffensive in November 1950, the engineers had to destroy many of the same bridges as U.S. forces again retreated south of Seoul. But lateral roads built by the engineers behind the new defensive lines proved critical when the Chinese broke through a portion of that line. These roads enabled the Americans to transport the 3d Infantry Division 100 miles in a single day to plug the hole that the Chinese had created.

As U.S. forces returned to the offensive in mountainous central Korea in early 1951, engineer units blasted cliffsides to build new roads and built aerial tramways to carry supplies to the troops. When the advancing 23d Regimental Combat Team and a French battalion were surrounded at Chipyong-ni on February 13, 1951, by an attacking force apparently comprised of three Chinese divisions, the engineer company supporting the combat team fought as infantry to assist it to withstand the attacks until an American armored relief column could reach the town two days later. In early October 1951, the 2d Engineer Combat Battalion converted a rough track leading north to Mundung-ni into a road usable by tanks, enabling an American tank battalion to surprise a Chinese column attempting to relieve hard-pressed Chinese troops on Heartbreak Ridge near the 38th parallel. This interception eased the capture of the ridge by U.S. and French forces. An Army engineer construction battalion supported the 1st Marine Division in its combat in mountainous central Korea during much of 1951.

Historical Division, Corps of Engineers

Building a "scrounge bridge" across the Pukhan River, April 1951.

The engineers confronted a critical challenge after the summer floods of July 1952 washed out two of the five high-level bridges across the Imjin River, located a mere four miles behind the battle lines of three U.S. Army divisions. After installing two temporary floating bridges, Army engineer troops built at the less critical site an innovative low-level bridge sturdy enough to survive if overtopped by flood waters. In the center of the I Corps line, the 84th Engineer Construction Battalion erected within range of the enemy's artillery a modern commercial-type highway bridge utilizing sheet-pile cofferdams and reinforced concrete piers. Dedicated to engineer Medal of Honor winner George Libby, that bridge remains in use and retains its tactical significance 30 years after its construction. In sum, the U.S. Army engineers in Korea compiled a very creditable record of combat and wartime construction that comple-

YAH-64 helicopter with anti-armor battle dress.

mented and often multiplied the combat effectiveness of the highly motorized U.S. forces engaged there.

The Army again called upon its engineers for combat support in Asia to assist the Republic of Vietnam. As in northern Korea, where Chinese troops had hidden their movements prior to their November 1950 offensive, in South Vietnam anti-government forces relied heavily upon a strategy of concealment in their combat with U.S. forces. U.S. Army operations in Vietnam thus did not occur along a well-defined front line but could break out wherever the Americans encountered guerrilla forces or North Vietnamese troops. The elusiveness of the enemy in Vietnam led U.S. Army engineers to alter in several ways the manner in which they pursued their task of enhancing the combat environment of friendly forces.

Search and destroy missions were frequently employed by American forces to attack areas of particular enemy strength. The 1st Engineer Battalion supported Operation Rolling Stone in Binh Duong Province near Saigon by building a road into the Iron Triangle and War Zone D, two staging areas frequently used by the Viet Cong. Men of this battalion engaged in a half-hour-long firefight with the enemy on February 26, 1966. The following summer a 52-bulldozer battalion task force cleared 2,700 acres of jungle, destroyed 6 miles of enemy tunnels, and demolished 11 factories and villages in the Iron Triangle.

The wide use of helicopter transport in Vietnam enabled U.S. forces to respond quickly to enemy attacks anywhere in Vietnam. After the airmobile 1st Cavalry Division relieved a besieged Special Forces camp at Plei Me in the Central Highlands in October 1965, a divisional engineer company lengthened and improved an earthen airfield at a nearby tea plantation using equipment brought in by helicopter. The division then forced the attacking North Vietnamese regiment to retreat west from Plei Me through the jungles of the Highlands. The division relied for forward supply and reinforcement in this campaign upon helicopter landing zones that were quickly cleared from the jungle

Engineer mine-sweeping team.

Historical Division, Corps of Engineers

Combat engineers of 173d Airborne Brigade search Ding Nai River for underwater bridge.

by divisional engineers employing chain saws and demolitions. By the time that the North Vietnamese regiment reached the safety of Cambodia, it and other regiments that had come to its aid had lost 1,800 men. During the next 10 months the 8th Engineer Battalion built seven airfields for the division in the Highlands, including one at a site eight miles from the Cambodian border to which all construction equipment, supplies and personnel had to be transported by helicopter. The battalion could do this because engineer planners had modified procurement orders for large earthmoving equipment to obtain machinery that could be disassembled for airlift and then quickly reassembled.

Various technological innovations aided the Army engineers in Vietnam. To combat the thick mud that could quickly disable the Army's tactical airfields in the monsoon season, the engineers employed the new T-17 membrane, a neoprene-coated fabric which they used to cover the airfields and provide them with an impermeable "raincoat." The engineers sprayed

Defense Audio Visual Agency

Installing T-17 membrane at Bao Loc.

peneprime, a dust palliative with an asphaltic base onto heliport sites during the dry season to prevent dust clouds from interfering with helicopter operations.

The use by guerrilla forces of the thick forests along the nation's major transportation routes to conceal themselves before laying mines or staging ambushes impelled the engineers to clear all vegetation up to 100 yards on either side of major roadways. Finding bulldozers and flammable napalm unequal to the task, the engineers in 1967 introduced the Rome Plow, a military tractor equipped with a protective cab and a special tree-cutting blade that was sharpened daily. Lieutenant General Julian Ewell, a high field commander in Vietnam, called the Rome Plow "the most effective device" in his arsenal. A land-clearing engineer company equipped with 30 Rome Plows could clear 180-200 acres of medium density jungle each day.

The enemy's Tet Offensive early in 1968 closed for over a month several critical roads, particularly in the northern part of the Republic of Vietnam. The Army's 35th Engineer Battalion, which had concentrated on road building during its previous service in Vietnam, reopened coastal Route 1 north of Da Nang in late February 1968 while assigned to the III Marine Amphibious Force. By this time the engineers had built a sufficient number of airfields, heliports, and troop cantonments to permit them to continue to concentrate on road construction. The 27th Engineer Battalion now built a new all-weather highway from Hue west to the A Shau valley, an enemy stronghold. Engineer units in the Mekong Delta developed a clay-lime coagulation process that they used there to build durable roads from locally available materials. The engineers protected their bridges by installing extensive lighting systems and anti-swimmer and anti-mine devices using concertina wire and booms. Overall, Army engineer troops constructed roughly 900 miles of modern, paved highways connecting the major population centers of the Republic of Vietnam. Engineer officers also monitored the construction by private American contractors of an additional 550 miles of Vietnamese highways.

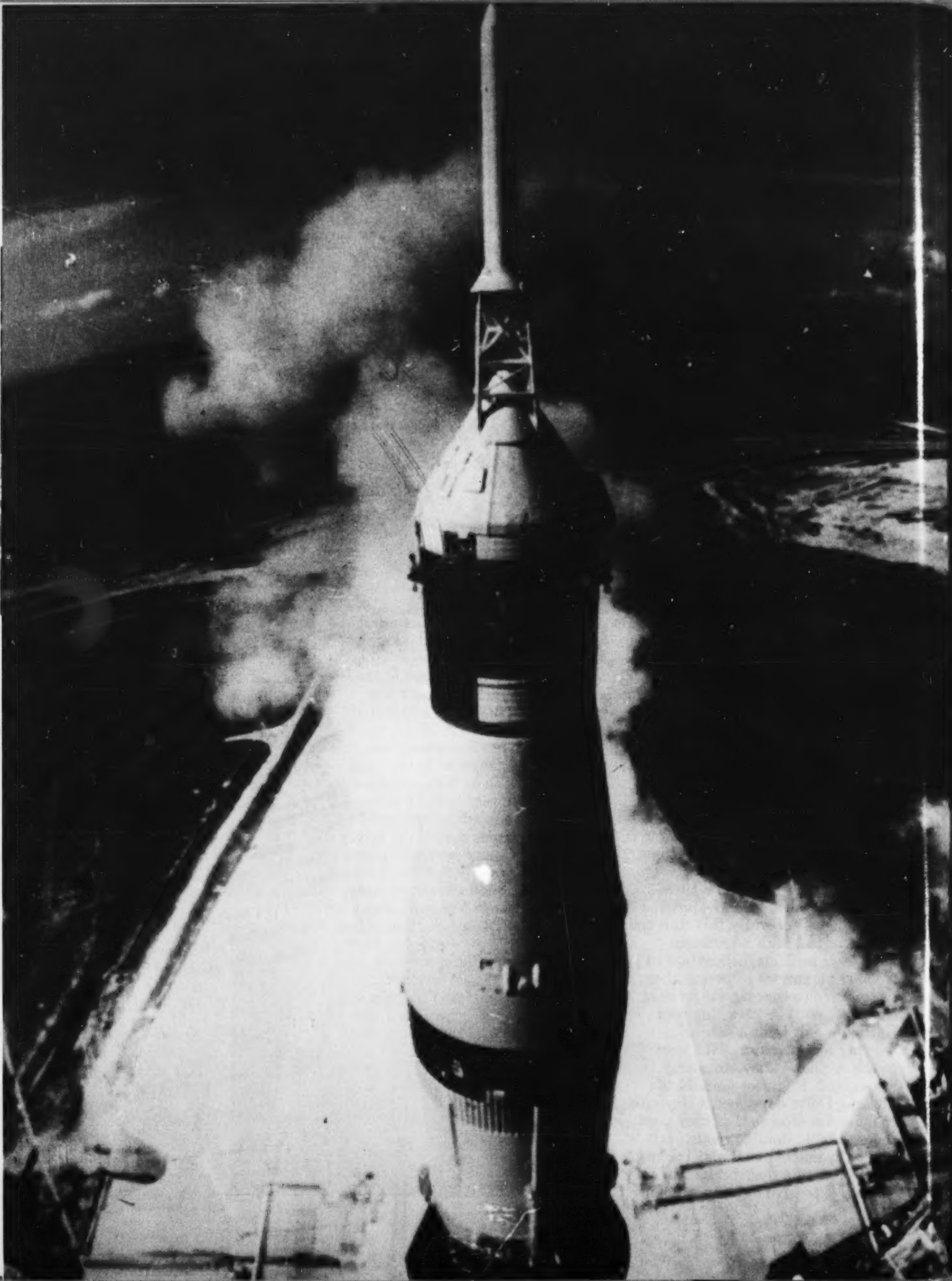
Army engineers also undertook certain responsibilities for installation security and these could involve heroic individual actions. When an enemy team infiltrated the base of the 173d Engineer Company at Camp Radcliff at An Khe in the Central Highlands on March 20, 1969, Engineer Corporal Terry Kawamura threw himself on an explosive charge that had been hurled into his quarters absorbing its blast and thereby protecting other members of his unit endangered in the attack. Corporal Kawamura was posthumously awarded a Medal of Honor.

A half-dozen Army engineer battalions participated in the Cambodian incursion in May and June of 1970. Engineers built 35 miles of new roads, 23 fixed bridges and 25 fire support bases during the attack on North Vietnamese supply points and staging areas within Cambodia. During this period the senior Army engineer officer in Vietnam, Major General John Dillard and two other high ranking Army engineers were killed when their helicopter was shot down southwest of Pleiku. These losses were illustrative of the dedicated support which the Corps of Engineers gave to the Army during its service in Vietnam.

Historical Division, Corps of Engineers

Engineer and Rome Plow of 60th Land Clearing Company.

Engineer tunnel demolition team.



Military Construction

Arnold Engineering
Development Center,
Tullahoma, Tennessee,
built for the Air Force

Public Affairs Office, Corps of Engineers

Historical Division, Corps of Engineers

Pentagon under construction,
August 1942

The military construction mission of the Corps of Engineers dates from the early days of World War II. Prior to that time, the Quartermaster Department built almost all Army facilities. By 1940 it was clear that this arrangement could not continue. Quartermaster resources were inadequate for the large mobilization job ahead. On the other hand, the engineers' civil works organization and experience provided the basis for absorption of the assignment. So, in November 1940, the War Department chose the Corps to build facilities for the Army Air Corps. Thirteen months later, the Corps undertook all construction for the Army's war effort.

This massive enterprise involved military and industrial projects. The Corps managed construction of a wide range of factories, most notably for the assembly of aircraft and tanks and the production of ammunition. Military installations included camps for 5.3 million soldiers, depots, ports and the Pentagon. Each of these tasks included planning, site selection, land acquisition, design, contract negotiations, procurement, labor relations and the construction itself. All told, the wartime mobilization program involved more than 27,000 projects and cost $15.3 billion, or approximately $100 billion in 1980 dollars. Lieutenant General Leslie R. Groves, head of the Manhattan Project, summed up the significance of this work for the successful conduct of the war: "Mobilization was decisive and construction generally controlled mobilization."

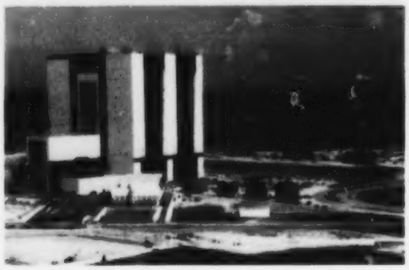
Yet there was more to engineer construction during the war than the stateside program. Work in support of the war against Japan ranged over a vast portion of the world, from Panama to India and from Alaska to Australia. A huge organization, which grew to include 236,000 engineer troops in an Army of 1,455,000, built pipelines, dredged harbors and built and repaired ports throughout the Pacific theater. Some of the accomplishments in this region rivaled those of the Corps on the homefront.

Among the major projects in the Pacific area was the air ferry route to the Philippines. To move heavy bombers west across the

Public Affairs Office, Corps of Engineers

Apollo launch

Vertical Assembly Building, Cape Kennedy.

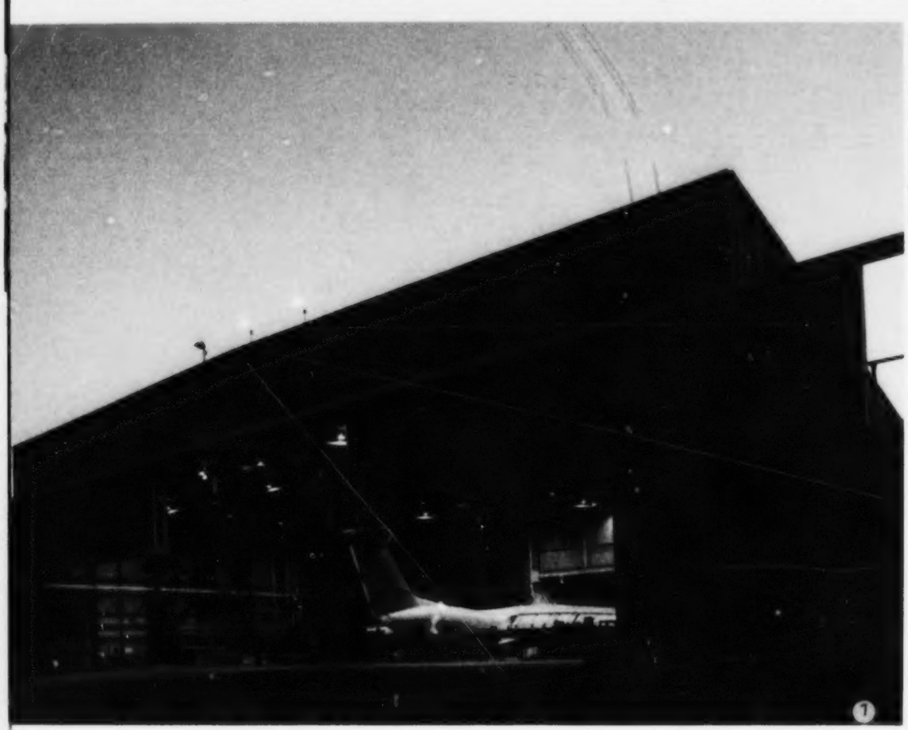


Public Affairs Office, Corps of Engineers

ocean, the Corps built airfields on a host of Pacific islands. The engineers developed these bases in a matter of a few months.

Two land routes also merit special notice. The Alcan Highway, prompted by the threat of a Japanese invasion and the closure of Alaskan sea routes, ran over 1,671 miles of muskeg and mountains. The project involved 133 major bridges and at the peak of construction employed 81 contractors and 14,000 men. Closer to the war, the Ledo Road from northeastern India to Burma crossed 430 miles of jungle, mountains and rivers. Alongside went the longest invasion pipeline ever built.

The war against Germany also



Historical Division, Corps of Engineers

Solar water-heating facility, Robins Air Force Base, Georgia.

Operation Blue Jay

One of the more challenging assignments given to the Corps in the post-World War II period was Operation Blue Jay, the construction of a complete and modern airfield on the bleak windswept Greenland plateau at Thule, well north of the Arctic Circle. The project, dropped on the desk of Lieutenant General Lewis Pick, Chief of Engineers, during Christmas week 1950, required molding a forbidding landscape to accommodate the needs of a sophisticated airfield. Army engineers moved millions of tons of rock and gravel, erected thousands of tons of steel and aluminum, and provided water, heat, power and all the conveniences of civilization. Moreover, the construction had to be done during the short summer period of daylight.

The reconnaissance force which flew into the area in February 1951 experienced savage blizzards, solidly frozen ground and temperatures well below zero. Meanwhile machinery was mobilized at home. Nobody was sure that ships could even reach such a remote outpost; the path across the sea was littered with the wrecks of ships which had failed. The Navy was called in to help and it supplied ice breakers, tankers, survey ships, big landing craft, salvage ships and barges. On July 15, the first of these vessels made it to Greenland, and there faced another challenge—landing the supplies. The beaches were strewn with boulders. Consequently, bulldozers and other equipment were flown in. Access roads and a dock were built. All this work required around-the-clock shifts. Before it was all over, a hundred ships had anchored off-shore, 4,000 men from all the Army technical services were assigned to the construction and 6,000 construction workers were employed to complete the airfield as quickly as possible. The result was the completion of almost all construction within 100 days. The Corps of Engineers had licked the Arctic.

Fitzsimons Army Hospital, Denver, 1952

demanded massive construction support. After building bases in Greenland and Iceland to protect Atlantic shipping, the Corps moved to England, where as many as 61,000 Army engineers created the ground and air facilities required to support the invasion of France. During the same period in North Africa, the Corps built many airfields for British and American air forces and provided ports and depots to support the invasion of Italy.

In June 1944, engineers moved into Europe with the Allied invasion. Operations included the rehabilitation of ports and railroads as well as airfield and depot construction. For example, engineers cleared and reconstructed the port of Le Havre using plans developed well before the advance into France. Large construction projects also included a camp and depot at Valognes, France, that served as headquarters for logistical forces of the Communications Zone. The post included tents for 11,000 soldiers and provided 560,000 square feet of hutted office space.

After the war, the Corps maintained a large presence in Europe. Engineers restored transportation networks and other public services in Germany and Austria. In France, during the early 1950s, the Corps performed a wide array of line of communications construction, from pipelines to supply depots, in anticipation of the need to reinforce units in Germany. With American troops still in Germany, engineer construction goes on there and includes hospitals, depots, billets and offices.

The Corps also remained with the occupation forces in Japan and met all of their building requirements. When war broke out in Korea, bases in Japan provided the springboard for the movement and supply of forces deployed against the North Koreans and Chinese. In Korea itself, engineers performed remarkable feats of road and bridge construction over extremely difficult terrain and provided ports and airfields for friendly forces. They rehabilitated water supply and sanitation systems that remain in use by the Republic of Korea, and they still provide construction support for American units stationed there.

Military construction after the Korean War expanded into numerous countries. Work continued in Europe and the Far East, but increasing Cold War tensions led to the establishment of bases elsewhere. Through the 1950s and into the 1960s, the Corps built early warning facilities and airbases in diverse locales, including Greenland, Morocco and Libya.

Of the new missions undertaken in the United States, the most significant ones came with the development of rockets and missiles for military purposes and exploration of space. When the National Aeronautics and Space Administration (NASA) was established in 1958, the Corps became its design and construction agent. During the first half of the 1960s, the new Canaveral District built a wide range of facilities for NASA at Cape Canaveral, the Kennedy Space Center and Patrick Air Force Base, Florida. The peak effort came in 1963-1965. During that period Canaveral District placed $391 million worth of construction, including the vertical assembly building at Cape Canaveral. This gigantic structure covered 7.5 acres and stood 526 feet tall. It enclosed 129.5 million cubic feet, nearly twice as much as the Pentagon.

During the same period the Corps absorbed another missile-related mission. The Corps of Engineers Ballistic Missile Construction Office (CEBMCO), established in 1960, built launch sites and related installations for the Atlas and Titan intercontinental ballistic missile. CEBMCO constructed missile sites at 22 Air Force bases in 17 states. The Corps continued construction support for missile systems in the 1970s, working through Huntsville Division on the Sentinel and Safeguard anti-ballistic missile programs. All the while, the Corps of Engineers provided design, real estate and construction service to the Army and Air Force as well as NASA and other government agencies.

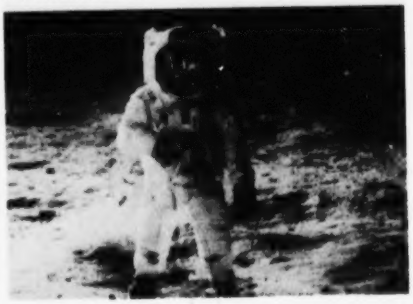
Preparations for ICBM test

The Corps and the Space Program

Pad 34 control room, Cape Kennedy

Public Affairs Office, Corps of Engineers

Man on the moon



Public Affairs Office, Corps of Engineers

With past experience in missile site construction, the Army Corps of Engineers was the logical choice of Congress and the National Aeronautics and Space Administration to oversee NASA's accelerated construction program in the early 1960s. Using the Corps also eliminated the need for NASA to establish a large temporary construction staff itself. NASA contracted with the Army engineers for small facilities as well as for major projects such as the Johnson Manned Spacecraft Center in Houston, Texas, the National Space Technology Laboratories in Pearl River County, Mississippi, and the Kennedy Space Center at Cape Canaveral, Florida.

On May 25, 1961, President John F. Kennedy declared a national goal of landing a man on the moon within the decade and returning him safely to Earth. In response, NASA began a massive construction program along the Gulf of Mexico and the Atlantic Ocean, an area called the "NASA Crescent." NASA needed a new logistics system, one that it necessarily had to construct around navigable waterways, because neither road nor rail could transport the gigantic components involved in the manned space program. Waterborne transportation was the only answer. Indeed, proximity to water was a factor in the selection of Houston for a new facility. On September 25, 1961, only three days after NASA requested the Corps'

Space shuttle *Enterprise* ready for lift-off.

assistance, the Fort Worth District began arranging preliminary topographic and utility surveys of the site of the manned spacecraft center.

Fort Worth District's experience with incremental funding stood NASA in good stead in the construction of the center. This method of funding is based on the congressional tradition of appropriating construction funds on a year-to-year basis. That meant the district contracted for each segment of the center as a separate unit. One virtue of this procedure was that it allowed significant changes in construction plans without delaying the project. For instance, on July 17, 1962, NASA announced that the future Mission Control Center would be located at the center. This decision forced the Corps to insert an entirely new building into its master plan for the center.

The incremental funding system also allowed for major modifications of facilities already under construction. This was important because speed was essential if NASA's goals were to be met, and the engineers and NASA had to construct buildings at the same time that NASA was designing the laboratories and machines they would contain. Troubles with the Space Environment Simulation Chamber showed the value of the arrangement. The failure of the chamber during its first vacuum test required not only its redesign but also numerous changes in the one-third-completed building. Incremental funding enabled contract modifications to be made without necessitating major delays. In November 1966, after spending some $75 million on the 1,600-acre project, Fort Worth District completed its work on what came to be called the Johnson Manned Spacecraft Center.

The Mobile District's involvement in NASA's rocket test program began with the transfer of the Army Ballistic Missile Agency's Development Operations Division at the George C. Marshall Space Flight Center at Redstone Arsenal, Huntsville, Alabama, to NASA in 1959. NASA then established the Michoud Assembly Facility near New Orleans as a support facility for the Huntsville projects. Michoud was the assembly plant for the large Saturn booster rockets. In the fall of 1961, NASA established its test facility for the rockets assembled at Michoud on a 217-square-mile tract at the Mississippi Test Center, later the National Space Technology Laboratories, accessible from Michoud by both land and water. Mobile District spent more than $20 million constructing space program facilities up to the completion of the test center in April 1966. The center's initial mission was to test the Apollo-Saturn V second stage booster and to test flight models of both the first and second stage boosters with thrusts of 7.5 million and 1 million pounds respectively. The site became NASA's principal test facility.

Cape Canaveral District served as NASA's construction agent for the John F. Kennedy Space Center, Florida, particularly in the engineering and construction of the Apollo Launch Complex 39 and its related industrial area, as well as Saturn Launch Complexes 34 and 57. Because the rocket motor assemblies required for lunar missions were the largest yet built, construction of the launch facilities at Complex 39 was on an unprecedented scale. The district and its civilian contractors for the Apollo program designed and built the vehicle assembly building, a structure large enough to handle the completion of four 363-foot Apollo-Saturn V launch vehicles; a launch control center; three 46-story mobile launchers, weighing 10.5 million pounds each; a 40-story mobile services structure to permit work on vehicles at the launch pads; two

Public Affairs Office, Corps of Engineers

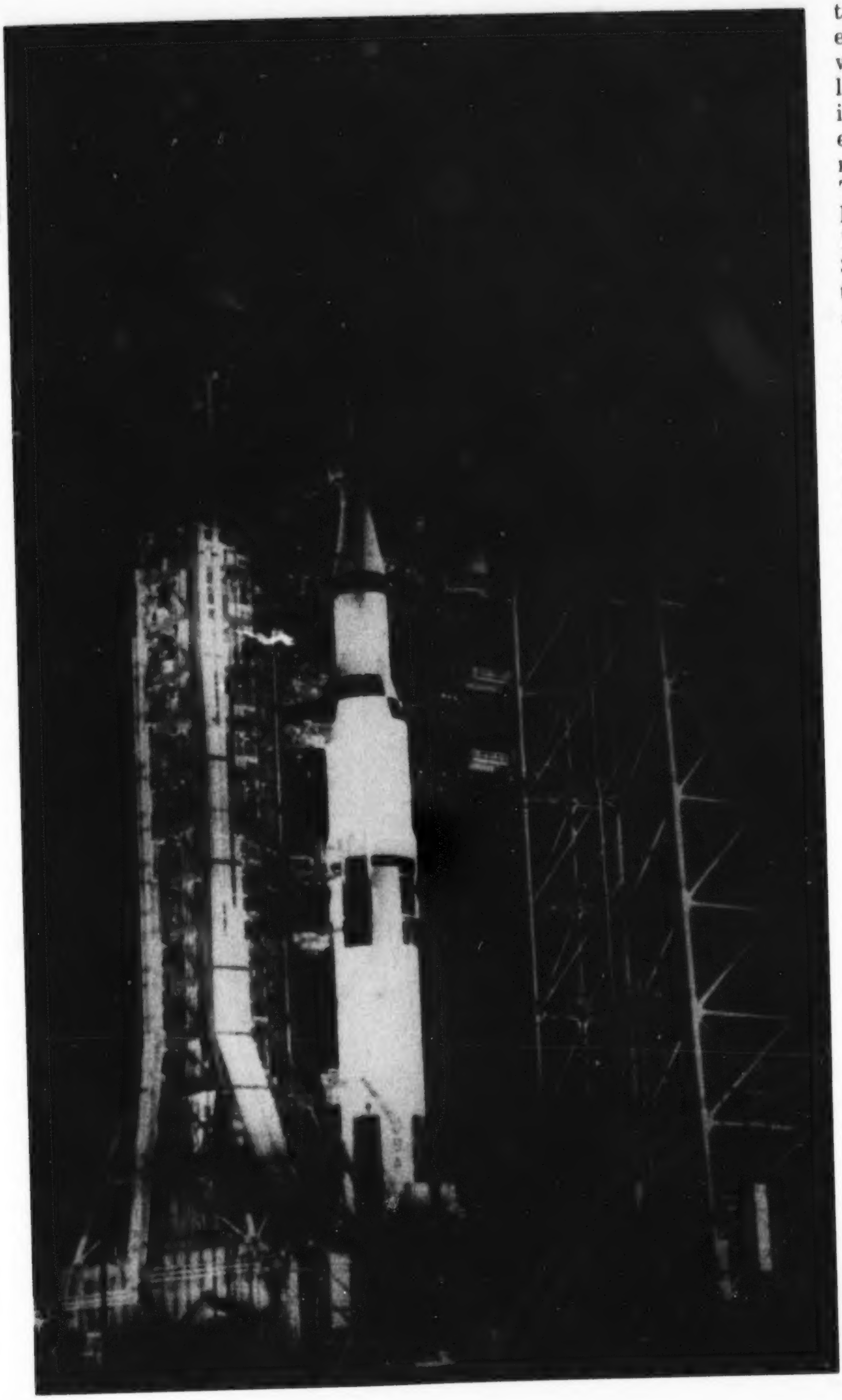
Space shuttle facility under construction, Vandenberg AFB, California.

Space shuttle facility, Vandenberg AFB.

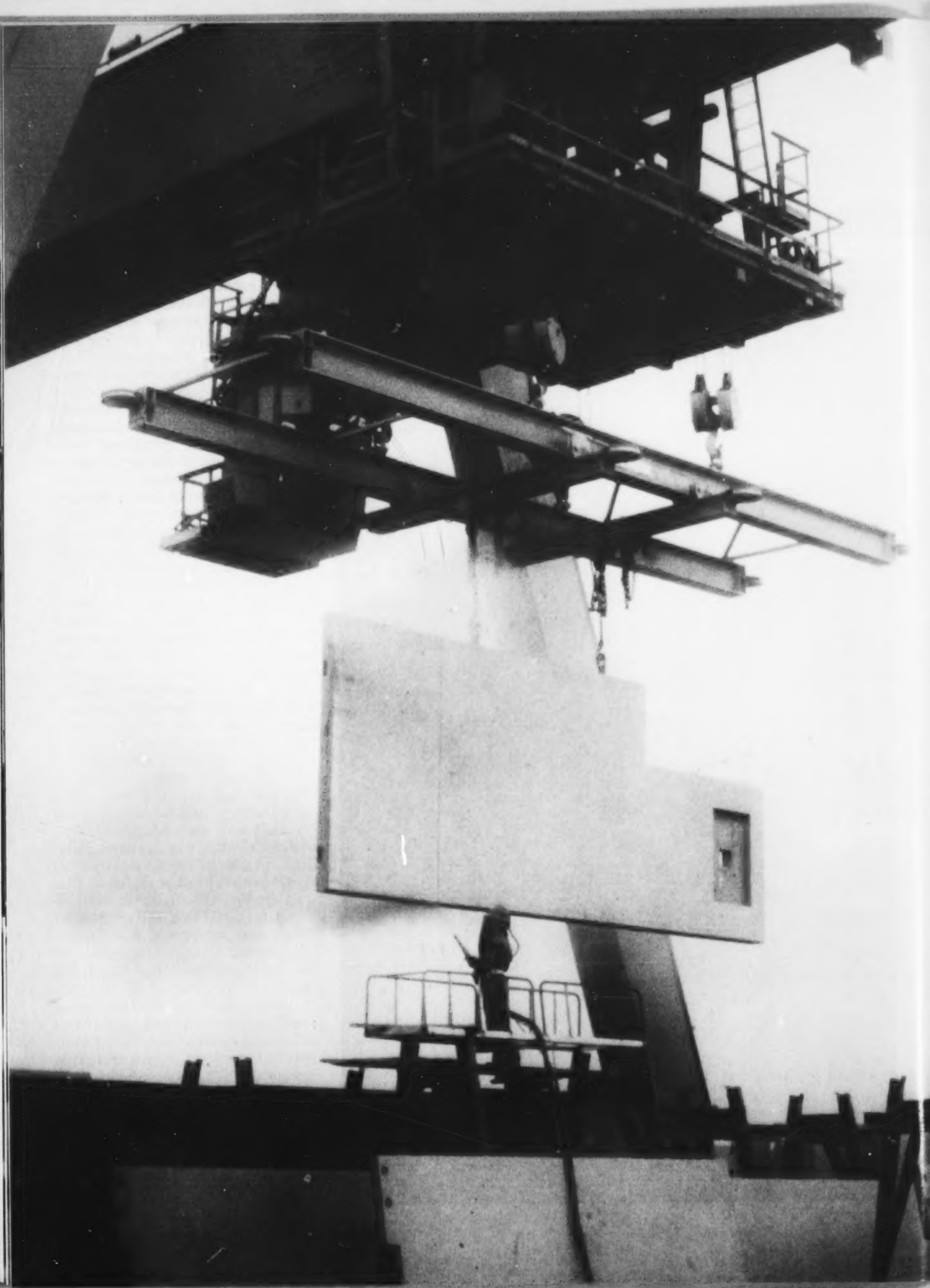
Public Affairs Office, Corps of Engineers

transporters for moving the launchers and service structure; a crawlerway road for the transporters; two launch pads, capable of withstanding the thrust from the Saturn V engines; and their integrating communications and electronics systems. The American Society of Civil Engineers recognized that work in 1966 with the selection of Complex 39 and its related facilities as the outstanding civil engineering achievement of the year.

Other Corps offices completed additional construction for NASA. For example, the New England Division selected the site for and supervised the construction of the Electronics Research Center in Cambridge, Massachusetts, in the late 1960s. That facility is now the Transportation Systems Center. In supervising a $1 billion NASA construction effort, Corps offices in all parts of the country made major contributions to the national space effort.



Saturn 4B launching
Apollo



Work for Other Nations

Reconstruction at Piraeus Harbor, Greece, February 1948

George C. Marshall

U.S. Army

Shortly after World War II, the Corps of Engineers became involved in massive foreign assistance programs sponsored by the United States. These efforts responded to two closely connected results of the war. In the first place, much of Europe was a shambles, characterized in many instances by physical devastation and political instability. These conditions made the continent vulnerable to the apparently expansive goals of the Soviet Union. As a result, in 1947 Congress approved Secretary of State George C. Marshall's plan to provide financial support for reconstruction programs developed by participating European nations and separate aid packages for Greece and Turkey, which appeared particularly vulnerable to subversion or aggression.

The 1951 Mutual Security Act extended the foreign assistance program to other portions of the globe. This law was passed in a period of growing international tension, marked by the Berlin blockade, the Communist success in China and the Korean War. The purpose of the legislation was maintenance of the national security and promotion of U.S. foreign policy through military, economic and technical assistance to strengthen friendly nations. This remains the fundamental goal of the program. The act consolidated a variety of efforts, including the Military Assistance Program, authorized in 1949 by the Mutual Defense Assistance Act, through which the United States offered help to allies in establishing defenses against external aggression and internal violence. The Mutual Security Act also included the program of technical assistance first articulated as Point Four of President Truman's 1949 inaugural address. Finally, the new law replaced the various economic aid programs with comprehensive loan and grant provisions.

The current basic law, the Foreign Assistance Act of 1961, established the Agency for International Development (AID) within the State Department to administer the major economic aid programs. More significantly for later Corps of Engineers activities, section 607 provided for the furnishing of services and commodities to foreign

Precast plant, King Khalid Military City, Al Batin, Saudi Arabia.

Public Affairs Office, Corps of Engineers

Public Affairs Office, Corps of Engineers

Dredging on the Suez Canal.

countries on a reimbursable basis. In the mid-1960s, this became the basis for major engineering programs.

Within the context of these laws, foreign assistance programs evolved to meet changing perceptions of the world situation and American interests. In the first period, from 1947 to 1952, economic aid predominated. During the Eisenhower years, from 1953 through 1960, most of the assistance from the United States was military. Then, in the decade that followed, an equilibrium was reached between economic assistance and military programs, including sales.

Other important trends shaped the role of the Corps in foreign programs. The emphasis on Europe during the early years after World War II, including Korean War bases in Middle Eastern and North African countries close to Europe, changed when the situation there stabilized. In the mid-1950s, the European share of American support dwindled to almost nothing, and the focus shifted to the Far East, South Asia and the Middle East. This trend coincided with another noteworthy tendency. During 1948-1952, most aid was in the form of grants. In fact, 90 percent of American help took the form of outright gifts. By the mid-1960s, 60 percent of economic aid was by loan.

The Corps of Engineers' contributions to these foreign programs took place in this context of evolving emphasis. Thus, during the immediate post-war years when American foreign policy and assistance programs emphasized Europe and particularly Greece and Turkey, the Corps was extremely active in these two nations. In Turkey, the Corps concentrated on construction of military facilities for Turkish and American armed forces. In Greece, after the State Department came to the Corps for technical expertise, the Corps restored a badly mauled transportation and communication network. The Grecian District, which was established in Athens in July 1947, cleared the Corinth Canal, restored the port of Piraeus, and built or repaired more than 3,000 kilometers of roads.

The Corps' operations in Greece established several major precedents. First was the organization of an engineer district to administer and supervise large-scale civil works in a foreign country. Second was the provision of technical assistance in conjunction with economic aid. Third, the practice of training indigenous contractors and artisans to perform as much of the actual work as possible began in Greece. And, fourth, the commitment to helping a friendly nation to help itself, which was manifested in projects aimed at restoring the Greek economy, became a standard feature of Corps projects.

During the 1950s, the Military Assistance Program dominated American overseas efforts. This program was one of two major Department of Defense foreign activities in which the Corps participated. First and most important was the maintenance and support of American forces in other lands. The other, the Military Assistance Program through which the United States aided the military forces of other nations, was directed largely toward supporting allies on the periphery of the Soviet Union and near the People's Republic of China.

In the period 1950-1964, this program dispensed assistance valued at more than $350 million. Iran, which was the largest single recipient, and four other nations—Pakistan, Turkey, Taiwan and Korea—received nearly all of the military assistance money. The projects carried out in Pakistan by the Trans-East District of the Mediterranean Division illustrate the nature of the work performed. In a massive modernization program for the Pakistani armed forces, the Corps built cantonments, airfields, wharves and marine railways.

While heavily involved in these efforts, the Corps also worked in programs of economic assistance. Projects intended to buttress a recipient nation's economy were administered by the AID and predecessor agencies. Corps participation in economic development programs actually predated the establishment of any of these agencies. As early as 1946, the Corps of Engineers worked with numerous Latin American governments to establish national cartographic programs. These efforts were ultimately intended to provide the basis for resource inventories of participating nations. After 1953, when the Department of State took over this program, the Corps continued to contribute to its success. Engineer personnel worked in 22 countries, developing programs, rendering procurement assistance, and administering contracts.

In the late 1950s the Corps began to undertake large projects within the economic assistance program. Between 1950 and 1964 the Corps produced major engineering studies for 17 different countries. These surveys dealt with beach erosion problems, river hydraulics, transportation networks and entire public works programs. Engineer personnel also examined the feasibility of various port and highway projects. The engineers also became involved in actual construction in eight countries. The major projects included airports, highway systems and ports. In the six years from 1959 through 1964, these efforts resulted in expenditures of $109.5 million.

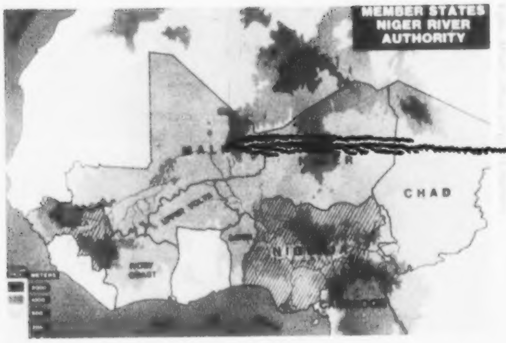
The Corps' work on these studies and construction projects reflected new directions in the overall program administered by the AID.

Enlisted quarters, King Khalid Military City.

In the years just prior to 1965, the focus was on long-term projects that supported broad economic development. In this framework engineering and construction loomed large and the Corps, with its unique capability to plan, organize and execute major building programs, made major contributions.

During the mid-1960s several developments led to changes in the Corps' role in foreign programs. AID changed its emphasis from major construction efforts aimed at improving economic infrastructures to more immediate needs for improvement of food supplies, public health and education. Moreover, the agency turned more to private engineering and architectural firms for support in this area. In so doing the agency cited for justification the provisions of section 601 of the Foreign Assistance Act of 1961, which encouraged maximum utilization of private resources instead of other government agencies.

The buildup of American armed forces in Vietnam also redirected the Corps' foreign operations. The maintenance and support of American forces in Southeast Asia took an ever-increasing portion of the Corps' resources. Moreover, Vietnam absorbed a growing percentage of the foreign aid budget, leaving less money for major projects in



1980 saw Corps support for navigation and planning in the Niger basin

Port of Owendo, Gabon, West Central Africa, site of Corps studies for AID.

Israeli airbase under construction.

Public Affairs Office, Corps of Engineers

other parts of the world. As AID turned its attention to Vietnam and Southeast Asia, it became involved in major geodetic and cartographic enterprises. The Corps of Engineers, with expertise already employed in a number of other nations, contributed again to resource inventory projects and the production of maps required for the land reform program of the government of South Vietnam. Thus, while the Corps' involvement in major construction projects dropped off, it still participated in other aspects of AID's work.

Even before these developments changed the character of Corps overseas projects, another major factor entered the picture. This was the beginning of Corps involvement in reimbursable programs funded by recipient nations instead of by United States loans and grants. Authorized by section 607 of the Foreign Assistance Act, these projects were based on bilateral agreement between the United States and nations that sought Corps technical expertise in development programs. The first of these was funded by the government of Saudi Arabia in 1963. There the Corps engaged in a large number of construction projects, including a variety of facilities for the Saudi Arabian armed forces and civil projects such as construction of radio and television communications installations.

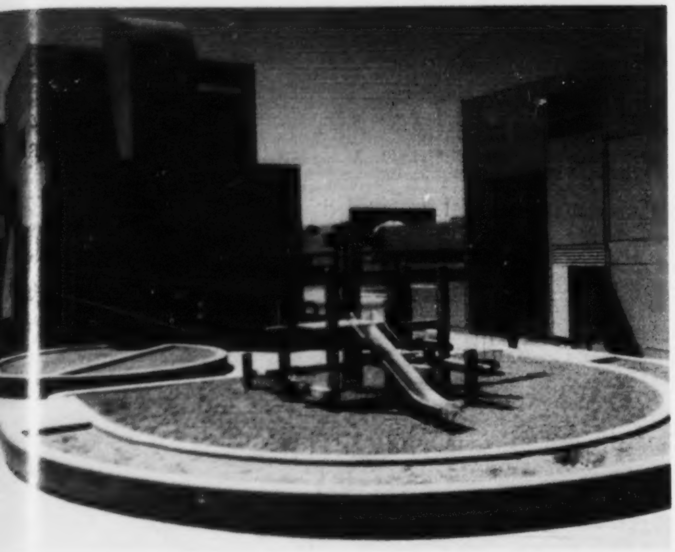
In the late 1960s and early 1970s, the number of reimbursable programs grew. In addition to the ongoing work in Saudi Arabia, where over $5 billion in construction has been completed, projects started in several other countries, among them Iran, Jordan, Kuwait and Libya. The Corps' effort in these nations improved the American balance of payments and provided valuable experience for engineer personnel while sharing the Corps' technical and professional expertise.

While managing reimbursable long-term projects, the Corps met more pressing requirements in the Middle East. In accordance with the Camp David agreement, the Corps built two airbases for Israel as replacements for those evacuated during the withdrawal from the Sinai. Finished in 1982, only three years after the start of construction, the bases cost about $1 billion, over three-fourths of which was an American grant. Meanwhile, the Corps also constructed Sinai base camps for the Multinational Force and Observers who patrol the demilitarized zone between Egypt and Israel.

Although the reimbursable programs of recent years mark a clear departure from the past in methods of funding, several similarities with earlier work remain. First is the nature of the work itself, large-scale construction projects in support of friendly nations' armed forces and economic development. In addition, the Corps continues to employ the well-tested organizational structure of the engineer district. Furthermore, some of the important precedents established during the late 1940s in Greece continue as hallmarks of Corps projects. These include the sharing of American technical know-how and the training of indigenous contractors and workers to provide as much of the actual work force as possible. Finally, and most significantly, the Corps' participation in these programs indicates that it remains unique among government agencies in its ability to plan, organize and carry out major construction programs.

Dhahran Airport, Saudi Arabia.

Public Affairs Office, Corps of Engineers



Public Affairs Office, Corps of Engineers

Housing courtyard, King Abdul Aziz Military Academy.

Strengthening the Free World: Rehabilitation in Greece 1947-49

The advantages of having a military-civilian engineer organization in being were demonstrated when the United States decided to help Greece recover from the devastation of war.

Soon after the end of World War II, Greece was torn by a civil war between Communist guerrillas and government troops. President Truman and Congress believed it was in the national interest to prevent a Communist takeover. To strengthen the anti-Communist forces, a program of economic aid to Greece was developed under the auspices of the State Department. A Greece on the road to economic recovery would be less likely to fall to Communism.

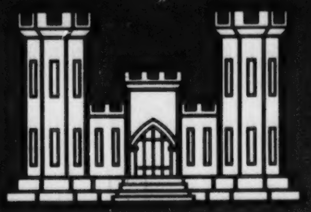
President Harry S. Truman appointed Dwight P. Griswold, a former governor of Nebraska, as the administrator of the recovery program. Soon after his arrival in Greece in July 1947, Griswold reported on the extensive devastation he found. The State Department decided that the reconstruction and rehabilitation of roads, railroads, bridges, ports and the Corinth Canal, one of the main Greek waterways, were of primary importance. Once the country's transportation system was restored and the ports were in operable condition, economic recovery would be more rapid.

The State Department received some 100 letters from construction firms interested in doing the work. The department was, however, unfamiliar with doing construction and letting contracts and had no organization to do the job. It sent representatives a number of times to the Office of the Chief of Engineers to get information regarding such matters as the selection of contractors, the types of contracts that could be used and the amount of the fee to be paid. The State Department concluded it would be unable to do the work because it did not have the know-how in dealing with contractors and had no organization to put into Greece. It asked the engineers, who had a far-flung civil works construction organization, to do the work. The Secretary of State requested the Secretary of War to assume responsibility for the job. Assigned to the Corps of Engineers in late July 1947, it was scheduled to be completed within a year.

The engineers set up the Grecian District with headquarters in Athens, with personnel to be largely drawn from divisions and districts, and entered into agreements with a number of contractors who formed joint ventures. In mid-August, Colonel David W. Griffiths, the new district engineer, some of his civilian employees and some of the contractors' employees arrived in Athens. Actual reconstruction began in mid-September with the clearing away of debris from the harbor of Piraeus, the port of Athens. Soon work was under way on the reconstruction of other ports, the reconstruction of wrecked railroad bridges and tunnels and on the upgrading of highways, which had deteriorated badly. The Corinth Canal was cleared of debris. Soon after arriving in Greece, Colonel Griffiths was given the additional duty of upgrading a number of airfields. All of this work had to be done rapidly and efficiently. As the Secretary of War wrote, "The War Department is on continual exhibition to the President, the Congress, the State Department and to Greece . . . and other interested nations." Colonel George W. Marvin, the chief engineer of the U.S. Army Group advising the Greek Army in its fight against the guerrillas, helped Colonel Griffiths by obtaining Greek Army units to provide security for men working on District projects.

The Corps reconstructed about 900 miles of highway, rebuilt three major ports, restored railroad bridges and tunnels totalling some two miles, and upgraded 10 airfields. The Corinth Canal was reopened after about 1 million cubic yards of earth and debris had been removed. Actual construction time was about a year and a half; the overrun resulted mainly from guerrilla attacks, unusually severe winter weather, and delays in getting supplies. Once again, the engineer military-civil organization made possible the efficient accomplishment of a mission.

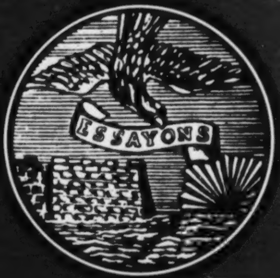
The Corps Castle



The appropriateness of the turreted castle as a symbol of the Corps of Engineers is readily apparent. The medieval castle is inseparably connected with fortification and architecture. In heraldry, the castle and the tower are often used in a coat of arms or given as charges in the shield of persons who reduced them, were the first to mount their walls in an assault, or successfully defended them. In this country the term "castle" has been applied to the strongest of our early fortifications, such as Castle Pinckney in Charleston, South Carolina, and Castles Williams and Clinton in New York Harbor, which, together with the entire system of permanent defense of our country, are particular achievements of the Corps of Engineers.

Possibly patterned after one of the city gates of Verdun, France, the castle is a highly conventionalized form, without decoration or embellishment. The Army officially announced the adoption of the castle, to appear on the Corps of Engineers' uniform epaulettes and belt plate, in 1840. Soon afterwards, the cadets at West Point, all of whom were part of the Corps of Engineers until the Military Academy came under the control of the Army-at-large in 1866, also wore the castle. Army regulations first prescribed the use of the castle on the cap in 1841. Subsequently, the castle appeared on the shoulder knot; on saddle cloth as a collar ornament; and on the buttons. Although its design has changed many times, the castle, since its inception, has remained the distinctive symbol of the Corps of Engineers.

The Essayons Button



The Corps of Engineers' oldest and most time-honored insignia is the exclusive Essayons Button. It has not changed in basic design since its first definitely known use during the War of 1812. It is still the required button for the Army Engineers' uniform.

Evidence which could establish the actual facts concerning the designing and adoption of the Essayons Button probably burned at West Point in 1838, when the building containing the library and earliest official Corps and Military Academy records caught fire.

However, while early Army regulations mentioned the "button of the Engineers . . . with only the device and motto heretofore established," apparently no authoritative detailed description of the button appeared until 1840. The Army prescribed new uniforms on February 18, 1840, in General Orders 7, AGO, which officially described the button as follows:

"An eagle holding in his beak a scroll with the word, 'Essayons,' a bastion with embrasures in the distance, surrounded by water, and rising sun; the figures to be of dead gold upon a bright field."

In 1902, when the Army adopted "regulation" buttons, it allowed only the Corps of Engineers to retain its own distinctive Essayons Button in recognition of the distinguished traditions that it symbolized.

Portraits and Profiles

Since 1775, 46 officers have held the highest office among the Army's Engineers. In addition, three officers headed the Topographical Bureau and the Corps of Topographical Engineers between 1818 and 1863. Their likenesses and biographies are on the following pages. Ranks listed are the highest ranks, excluding brevet ranks, attained while in office.

Colonel Richard Gridley

America's First Chief Engineer

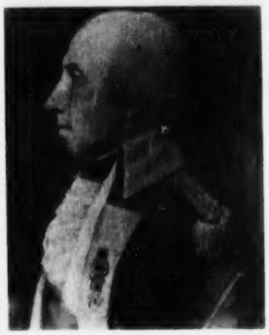
(June 1775-August 1776)

Born January 3, 1710, at Boston, Mass., Colonel Richard Gridley was the outstanding American military engineer during the French and Indian Wars from the Siege of Louisburg in 1745 to the fall of Quebec. For his services he was awarded a commission in the British Army, a grant of the Magdalen Islands, 3,000 acres of land in New Hampshire, and a life annuity. When the break with the mother country came, he stood with the colonies and was made Chief Engineer in the New England Provincial Army. He laid out the defenses on Breed's Hill and was wounded at the Battle of Bunker Hill. He was appointed Chief Engineer of the Continental Army after Washington took command of that Army in July 1775. He directed the construction of the fortifications which forced the British to evacuate Boston in March 1776. When Washington moved his Army south, Gridley remained as Chief Engineer of the New England Department. He retired in 1781 at age 71. He died June 21, 1796, at Stoughton, Mass.

Colonel Rufus Putnam

Chief Engineer (Continental Army)

(August 5, 1776-December 1776)

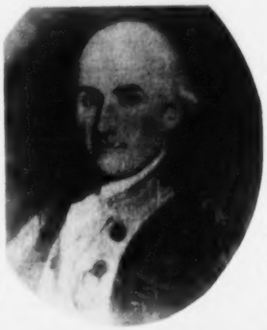


Colonel Rufus Putnam was born April 9, 1738, at Sutton, Mass. A millwright by trade, his three years' Army service during the French and Indian War influenced him to study surveying and the art of war. After the Battle of Lexington, he was commissioned an officer of the line, but General Washington soon discovered his engineering abilities and made him Chief Engineer, in charge of the defenses of New York. Putnam's work in the planning and construction of the defenses of West Point were notable. Fort Putnam, built in the manner of Vauban, still stands to honor his name at the U.S. Military Academy. In 1788 he led the first settlers to found the present town of Marietta, Ohio. The fortifications which he built there saved the settlements from annihilation during the disastrous Indian Wars. He became Surveyor General and Judge of the Supreme Court of Ohio and died at Marietta May 1, 1824.

Major General Louis Lebègue Duportail

Chief Engineer (Continental Army)

(July 22, 1777-October 10, 1783)



One of General Washington's most trusted military advisors, General Duportail was born near Orleans, France, in 1743. He graduated from the royal engineer school at Mezières as a qualified engineer officer in 1761. He was commissioned lieutenant colonel, Royal Corps of Engineers, and was secretly sent to America by Benjamin Franklin and King Louis of

Unless otherwise noted, photos from Historical Division, Corps of Engineers

France to serve in Washington's Army in March 1777. He was appointed colonel and Commander of all engineers in the Continental Army, July 1777; brigadier general, November 1777; Commander, Corps of Engineers, May 1779; major general (for meritorious service), November 1781; and retired, October 1783. Returning to France, he became French War Minister in 1790. Condemned to death, he escaped to America in 1792 and bought a farm near Valley Forge. He lived there until 1802, when he died at sea.

Lieutenant Colonel Stephen Rochefontaine

Commandant, Corps of Artillerists and Engineers (February 26, 1795-May 7, 1798)

Born in France in 1755, Stephen Rochefontaine was a lieutenant in the French Royal Corps of Engineers when he arrived in America May 15, 1778, and volunteered in General Washington's Army. He was appointed captain in the Corps of Engineers September 18, 1778. For his distinguished services at the Siege of Yorktown, Rochefontaine was brevetted a major by Congress, November 16, 1781. He returned to France in 1783, but escaped to America soon after the king was executed. President Washington appointed him a civilian engineer to fortify the New England coast in 1794. After the new Corps of Artillerists and Engineers was organized, Washington made Rochefontaine a lieutenant colonel and Commandant of the new Corps on February 26, 1795. Rochefontaine started a military school at West Point in 1795, but the building and all his equipment were burned the following year. He retired from the Army May 7, 1798, and lived in New York City, where he died January 30, 1814. He is buried in old St. Paul's Cemetery in New York.

Lieutenant Colonel Henry Burbeck

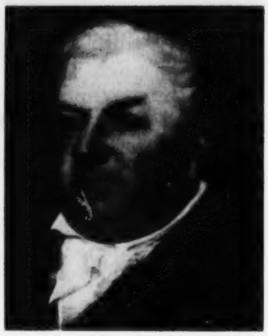
Commandant, Corps of Artillerists and Engineers (May 7, 1798-April 1, 1802)

Born June 8, 1754, at Boston, Mass., Henry Burbeck served as lieutenant of Artillery under Colonel Gridley, the Army's First Chief Engineer and Artillery Commander, in 1775. He remained in the Artillery Corps under General Knox, with Washington's Army, until the Yorktown Campaign. His command remained in the North to defend the Hudson Highlands and had the signal honor of marching into New York when the British evacuated that city at the close of the war. Honorably discharged in 1784, he was reappointed captain of Artillery to command Castle William in Boston Harbor (1787)—his father's old command before the Revolution. He commanded Springfield Arsenal (1787) and West Point (1787-89) and was General Wayne's Chief of Artillery in the Northwest (1792). He built Fort Recovery and succeeded Rochefontaine as Commandant and remained as senior officer after a second regiment was added to the Corps in 1798. He was Military Chief, Eastern Department of the Army, in 1800 and was active in establishing the Military Academy at West Point. He was Chief of the New Artillery Corps from 1802 until his retirement in 1815. He died October 2, 1848, at New London, Conn.

Colonel Jonathan Williams

Chief Engineer (and First Superintendent of West Point) (April 1, 1802-July 31, 1812)

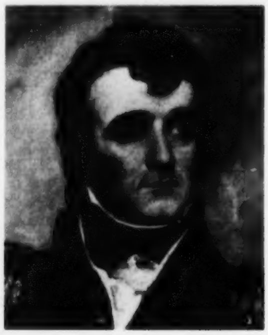
Jonathan Williams was born May 20, 1750, in Boston, Mass., the grandnephew of Benjamin Franklin. Williams spent most of the period 1770-85 in England and France where he assisted Franklin with business affairs and served as a commercial agent at Nantes. He joined the American Philosophical Society in 1788. He was major, Corps of Artillerists and Engineers and Inspector of Fortifications in 1801. The following year President Jefferson appointed him to command the newly created Corps of Engineers and the Military Academy at West Point, which was established by Congress on March 16, 1802. As "Principal Engineer," Williams became First Commander and Chief Engineer of the present Corps and First Superintendent of West Point. From 1807-1812, as colonel and Chief Engineer, he designed and completed construction of Castle Williams, the first casemated battery in the United States. He founded the U.S. Military Philosophical Society (its motto, "Science in War is the Guarantee of Peace"). He resigned from the Army in 1812 and was heading a group of volunteer engineers who built fortifications around Philadelphia when elected to Congress in 1814. He died at Philadelphia, May 16, 1815.



Colonel Joseph Gardner Swift

Chief Engineer (July 31, 1812-November 12, 1818)

Born December 31, 1783, at Nantucket, Mass., Joseph Swift was appointed a cadet by President Adams and was one of the two first graduates of West Point (Class of 1802). He constructed Atlantic coast fortifications 1804-1812 and was only 28 years old when appointed Colonel, Chief Engineer, and Superintendent of West Point in 1812. As Chief Engineer of the Northern Army, he distinguished himself at the Battle of Chrysler's Farm, November 11, 1813. After completing defensive works of New York, Swift was voted "Benefactor to the City" by the corporation in 1814. He helped to prepare a new system of infantry tactics and to rebuild the burned capital at Washington. He also reorganized the academic staff and planned new buildings at West Point.



He resigned from the Army, November 12, 1818. He was one of the founders of the first New York Philharmonic Society in 1823. As chief engineer for various railroads, he laid the first "T" rail. He was Superintendent, Great Lakes Harbor Improvements, 1829-45, and died July 23, 1865, at Geneva, N.Y.

Colonel Walker Keith Armistead

Chief Engineer
(November 12, 1818-June 1, 1821)

Born in Virginia about 1780, Armistead was a cadet in the old Corps of Artillerists and Engineers and continued as cadet at the new Military Academy in 1802. He was the third to graduate (March 5, 1803). Commissioned in the Corps of Engineers upon graduation, he reached the grade of lieutenant colonel in the War of 1812. He was Chief Engineer, Niagara Frontier Army and forces defending the Chesapeake Bay. Before and after that war he served as superintending engineer of various coast defenses and was appointed colonel and Chief Engineer, November 12, 1818. When the Army was reorganized, June 1, 1821, he became colonel, 3rd Artillery. He was brevetted brigadier general in 1828. He commanded the Florida Army against the Seminole Indians, 1840-41, and later commanded the 3rd Artillery. He died at Upperville, Va., October 13, 1845. General Armistead was the father of the gallant General Lewis A. Armistead, C.S.A., killed as he led Pickett's charge at Gettysburg.

U.S. Military Academy

Colonel Alexander Macomb

Chief Engineer
(June 1, 1821-May 24, 1828)

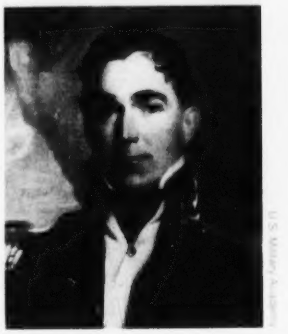
Born April 3, 1782 at Detroit, Mich., Alexander Macomb entered the Army as Cornet of Cavalry in 1799.

He was appointed second lieutenant, Infantry; first lieutenant, Corps of Engineers, 1802; lieutenant colonel, 1810; and made adjutant general, U.S.A. and colonel, 3rd Artillery, 1812. As brigadier general, he commanded the Lake Champlain Frontier Army and defeated the Duke of Wellington's Veterans at Plattsburgh in 1814. He was voted thanks and a gold medal by the Congress and brevetted major general. In the reorganized Army, he was appointed colonel, Corps of Engineers and Chief Engineer, 1821. From that position he was elevated to be Commanding General of the Army in 1828. He died June 25, 1841, at Washington and was buried with the highest military honors in the Congressional Cemetery. Macomb made the earliest known drawing (1807) to resemble the Engineer Button, and he was the Army's Commanding General when the castle insignia was designed 32 years later.

Colonel Charles Gratiot

Chief Engineer
(May 24, 1828-December 6, 1838)

Charles Gratiot was born August 29, 1786, at St. Louis. President Jefferson appointed him cadet from Missouri Territory in 1804. He was graduated from West Point, Class of 1806, and commissioned in the Corps of Engineers. He became a captain in 1808 and assisted Macomb in constructing fortifications at Charleston, S.C. He was post commander of West Point, 1810-11. He distinguished himself as General William Henry Harrison's Chief Engineer in the War of 1812. He was appointed Chief Engineer, Northwest Territory, 1817-18; and superintending engineer, construction of Hampton Roads defenses, 1819-28. On May 24, 1828, Gratiot was made colonel of engineers, brevetted brigadier general and Chief Engineer. General Gratiot was a brave and distinguished engineer officer for 32 years, but his overzealous attitude regarding interpretation of the law in rendering his accounts caused his dismissal from the Army by President Van Buren in 1838. The Commanding General and fellow officers sympathized with Gratiot and felt the President's action was too harsh. Gratiot became a clerk in the General Land Office and died May 18, 1855, at St. Louis.

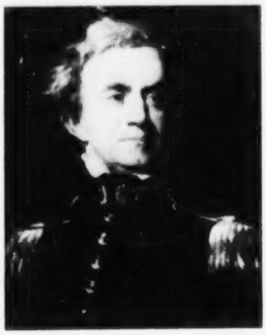


U.S. Military Academy

Brigadier General Joseph Gilbert Totten

Chief Engineer
(December 7, 1838-April 22, 1864)

Born August 23, 1788, at New Haven, Conn., Joseph Totten was graduated from West Point and commissioned in the Corps of Engineers, July 1, 1805. He resigned in 1806 to assist his uncle, Jared Mansfield, Surveyor-General, Northwest Territory. He re-entered the Corps and assisted in building "Castle Williams" and other New York Harbor defenses, 1808-12. At age 24 he became Chief Engineer, Armies of Niagara and Champlain. He was brevetted lieutenant colonel for gallant conduct in the Battle of Plattsburgh. As a member of the first permanent Board of Engineers, 1816, he laid down principles of coast defense construction that were followed for 100 years. Appointed Chief Engineer in 1838, he served 26 years. He was greatly admired by General Scott, for whom he directed the siege of Vera Cruz during the Mexican War. He was Regent of the Smithsonian Institution and cofounder of the National Academy of Sciences. He died April 22, 1864, at Washington, DC.



Major Isaac Roberdeau

Chief, Topographical Bureau
(August 1, 1818-January 15, 1829)

Isaac Roberdeau was born in Philadelphia on September 11, 1763. He studied engineering in London, returning to America in 1787 to write, survey and pursue astronomy. In 1791-1792 he assisted L'Enfant in planning the new federal city, the future Washington, DC. For the next two decades he practiced engineering in

Pennsylvania. His work included assisting William Weston on a canal connecting the Schuylkill and Susquehanna rivers. During the War of 1812 he served in the Army as a major of topographical engineers, employed chiefly on fortifications.

Retained after the war as a civil engineer, Congress reappointed him to his former rank of major and then, in 1818, appointed him to head the newly created office of the War Department, the Topographical Bureau. At first he was chief only in name—his duties were largely custodial. He prepared returns and maintained books, maps and scientific equipment. As the nation turned its attention to internal improvement, Roberdeau also used his position to promote the civil activities of the topographical engineers. He was brevetted a lieutenant colonel in 1823.

The Historical Society of Pennsylvania

Roberdeau's writings included *Observations on the Survey of the Seacoast of the United States* published in 1827 and an unpublished work, "Mathematics and Treatise on Canals." He died on January 15, 1829.

Colonel John James Abert

Chief, Topographical Bureau
(March 19, 1829-April 11, 1861);
Chief, Corps of Topographical Engineers
(July 7, 1838-April 11, 1861)

Born September 17, 1788, at Frederick City, Md., Abert was the 71st graduate of West Point (class of 1811). Resigning upon graduation, he became a civilian employee of the War Office at Washington. He volunteered as a private for the defense of Washington (1814) and was brevetted major, Staff Topographical Engineer, for gallantry at the Battle of Bladensburg, August 24, 1814. He made important surveys of the Atlantic coast and inland frontiers 1816-27 and was appointed Chief, Topographical Bureau, 1829 and Chief of the Corps of Topographical Engineers, 1838. Until consolidation of the two corps in 1863, this corps had charge of surveys of canals and roads, Great Lakes and rivers and harbors. The vast geographical and other vital information published by this corps "challenged the admiration of the scientific world," and charted land and water highways, including great transcontinental routes, for the westward march of America. Col. Abert retired September 9, 1861, and died January 27, 1863, at Washington, DC. He was a member of many scientific and historical societies, including the Geographical Society of Paris, France.

Colonel Stephen H. Long

Chief, Topographical Bureau, and Chief, Corps of Topographical Engineers
(September 9, 1861-March 3, 1863)

Born in Hopkinton, N.H., December 30, 1784, Stephen Long was graduated from Dartmouth in 1809 and commissioned in the Corps of Engineers in 1814. Brevetted major, Topographical Engineers, April 1816, he conducted extensive explorations and surveys in the Northwest and Rocky Mountains. Long Peak was named in his honor. He fixed the northern boundary at the 49th parallel at Pembina in 1823. He was a member of the Board of Engineers and Chief of Surveys, B. & O. Railroad, 1827. An authority on railroads, he authored the first "Railroad Manual" in 1829. He served for years as chief engineer for improvement of the western rivers, with headquarters at Louisville and later at St. Louis. He became Chief, Corps of Topographical Engineers, in 1861. Upon consolidation of the two corps, March 3, 1863, Colonel Long became senior officer to the Chief Engineer, Corps of Engineers. He retired that year and died at Alton, Illinois, September 4, 1864.

Brigadier General Richard Delafield

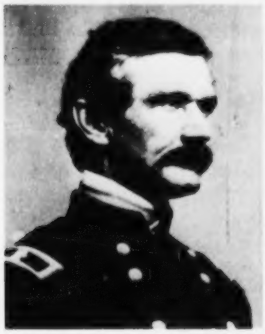
Chief Engineer
(April 22, 1864-August 8, 1866)

Born September 1, 1798, in New York City, Richard Delafield was the first graduate of West Point to receive a merit class standing and was ranked No. 1, Class of 1818. Commissioned in the Corps of Engineers, he was a topographical engineer with the American commission to establish the northern boundary under the Treaty of Ghent. He served as assistant engineer in the construction of Hampton Roads defenses (1819-24) and was in charge of fortifications and surveys of the Mississippi River delta area (1824-32). While Superintendent of the Cumberland Road, he designed the first cast iron tubular-arch bridge in the United States. Appointed Superintendent of West Point after the fire in 1838, he designed the new buildings and the new cadet uniform on which was first displayed the castle insignia. He superintended projects of Atlantic coast defenses and Department of Texas (1845-55), was military observer of the siege of Sebastopol and was again Superintendent of West Point (1856-61). He was in charge of New York Harbor defenses (1861-64) and Chief Engineer from 1864 until his retirement in 1866. He died November 5, 1873, at Washington. The Secretary of War ordered that 13 guns be fired in his memory at West Point.

Brigadier General Andrew Atkinson Humphreys

Chief of Engineers
(August 8, 1866-June 30, 1879)

Humphreys was born November 2, 1810, at Philadelphia, the son and grandson of chiefs of naval construction. His grandfather designed "Old Ironsides." Young Humphreys was graduated from West Point in 1831 and served as an Artillery officer until his resignation from the Army in 1836. He was appointed first lieutenant in the new Corps of Topographical Engineers in 1838. He made a survey of the Mississippi River delta, had charge of the Washington offices for coast survey and made explorations and surveys for railroads from the Mississippi River to the Pacific and geographical explorations west of the Mississippi. His *Report Upon the Physics and Hydraulics of the Mississippi River*, translated into several languages, remains a classic in hydraulic literature. General Humphreys, a distinguished Civil War Army corps commander, became Chief of Engineers in 1866 and established the Engineer School of Application. Humphreys held a Harvard degree, published Civil War histories, was co-founder of the National Academy of Sciences and was a member of many learned societies. He died December 27, 1883, at Washington, DC.



Brigadier General Horatio Gouverneur Wright

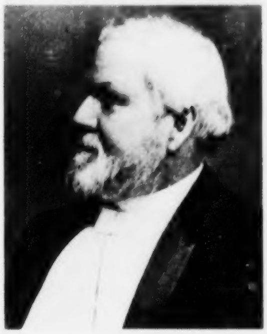
Chief of Engineers
(June 30, 1879-March 6, 1884)

Born March 6, 1820, at Clinton, Conn., General Wright ranked No. 2 when graduated at West Point (Class of 1841) and commissioned in the Corps of Engineers. He superintended construction at Fort Jefferson at Tortugas, Florida, 1846-56. While Assistant Chief Engineer of the Army, 1856-61, he was a member of boards to study iron carriages for seacoast guns and the adaptability of the 15-inch gun for ordnance. He co-authored "Report on Fabrication of Iron for Defenses." From chief engineer of a division, first Battle of Bull Run, he advanced to command the famous 6th Army Corps, which saved Washington City from capture in 1864 and later spearheaded the final assault on Petersburg and pursuit of Lee to Appomattox in 1865. He commanded Department of Texas (1865-66) and served as Assistant Chief of Engineers and a member of many top engineering boards until appointed Chief of Engineers in 1879. General Wright retired March 6, 1884, and died July 2, 1899, at Washington, DC.

Brigadier General John Newton

Chief of Engineers
(March 6, 1884-August 27, 1886)

Born August 24, 1823, at Norfolk, Va., Newton ranked No. 2 in the West Point Class of 1842 and was commissioned in the Corps of Engineers. He served as Professor of Engineering at the Academy (1843-46) and constructed fortifications along the Atlantic coast and Great Lakes (1846-52). He was a member of a special coast defense board (1856) and Chief Engineer, Utah Expedition, 1858. Though a fellow Virginian, he did not follow Lee, but stood staunch for the Union. He helped construct Washington defenses and led a brigade at Antietam. As division commander, he stormed Marye's Heights at Fredericksburg. He commanded a fighting division in Sherman's Atlanta campaign in 1864 and occupied the Florida districts, 1864-66. Returning to the Corps, he had charge of New York Harbor defenses and served on numerous boards from 1866 until appointed Chief of Engineers in 1884. He is famed for blowing up Hell Gate Rock. He retired from the Army in 1886 and served as Commissioner of Public Works, New York City, 1886-88, and as President of the Panama Railroad Company in 1888. He died May 1, 1895, at New York.



Brigadier General James Chatham Duane

Chief of Engineers
(October 11, 1886-June 30, 1888)

Duane was born June 30, 1824, at Schenectady, N.Y. His grandfather was a member of the Continental Congress and the first mayor of New York. Duane was graduated from Union College in 1844 and from West Point, Class of 1848, in which he ranked No. 3. He taught practical military engineering there (1852-54) during the superintendency of Robert E. Lee. He led the celebrated 1,100-mile march of "A" Company to Utah in 1858 and commanded select engineer troops to guard President Lincoln at his inauguration in 1861. He built the first military ponton bridge over the Potomac at Harpers Ferry in 1862, served as Chief Engineer, Army of the Potomac (1862-65) and in seven hours built the longest ponton bridge (2,170 feet) across the James River. He also served as Commander of Willets Point, Superintending Engineer of Atlantic Coast Defenses and member of the Board of Engineers for Fortifications and River and Harbor Improvements. Appointed Chief of Engineers in 1886, he retired in 1888. He then became Commissioner of Croton Aqueduct, N.Y. He authored the Manual for Engineer Troops and "Organization of Bridge Equipage of U.S. Army." General Duane died December 8, 1897, in New York City.

Brigadier General Thomas Lincoln Casey

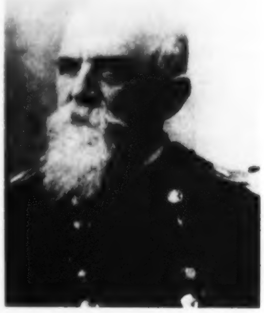
Chief of Engineers
(July 6, 1888-May 10, 1895)

Thomas Casey was born May 10, 1831, at Sackett's Harbor, N.Y., where his father (General Silas Casey, hero of Chapultepec) then commanded. Young Casey was graduated No. 1, Class

of 1852, at West Point and taught engineering there, 1854-59. The Corps' most distinguished builder of monuments and public buildings, Casey became Superintendent Engineer for Public Buildings and Grounds, District of Columbia, in 1877. He built the State-War-Navy Building and completed the Washington Monument. The straightening of and the placing of a new foundation under the Washington Monument (already 173 feet high) was Casey's greatest engineering feat, but his crowning accomplishment was construction of the Library of Congress building—all but completed when death came to him suddenly on March 25, 1896. Burial was at the Casey farm in Rhode Island. General Casey was a member of the National Academy of Sciences, Society of the Cincinnati and an officer of The Legion of Honor of France.

Brigadier General William Price Craighill

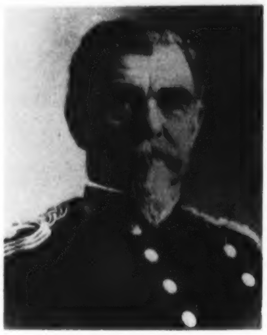
Chief of Engineers
(May 10, 1895-February 1, 1897)



William Craighill was born July 1, 1833, at Charles Town, Va. (now W. Va.). A classmate of Sheridan, Hood and McPherson, he ranked No. 2 in the West Point Class of 1853 and was commissioned in the Corps of Engineers. After constructing Fort Delaware, he was professor of Engineering at West Point, 1859-62. Another Virginian who stood for the Union, Craighill was division and department Chief Engineer during the Civil War and a member of boards for the defenses of San Francisco and New York, 1864-65. He superintended construction of defenses at Baltimore Harbor (1865-67) and Hampton Roads, 1870-74. He was stationed at Baltimore (1870-95) as Supervising Engineer for works in Maryland, Delaware, Virginia and North Carolina and was a board member for Coast Defenses and Rivers and Harbors Improvements. He established the camp for the Yorktown surrender celebration, the first of the sanitary type later adapted to Army camps. He was appointed Chief of Engineers by President Cleveland in 1895. He retired two years later and died January 18, 1909, at Charles Town, W. Va.

Brigadier General John Moulder Wilson

Chief of Engineers
(February 1, 1897-April 30, 1901)



John Wilson was born October 8, 1837, in Washington, DC. He was graduated in the West Point Class of 1860 and commissioned in the Corps of Artillery. He transferred to the Corps of Topographical Engineers in July 1862 and was awarded the Medal of Honor for most distinguished gallantry in action at Malvern Hill in 1862. He transferred to the Corps of Engineers in 1863 and received three brevets for gallantry. After the Civil War, he was on rivers and harbors work and construction of fortifications, public buildings and monuments throughout the nation. Wilson was Superintendent of the Academy at West Point (1889-93) and prior to appointment as Chief of Engineers, was Division Engineer, Northeastern Division. As Chief of Engineers, he directed the Corps' activities during the Spanish-American War and ordered official adoption of the present seal of the Corps. He retired April 30, 1901. One of the last of the Medal of Honor heroes of the Civil War to become Chief of Engineers, General Wilson remained a prominent figure in Washington until his death there, February 1, 1919.

Brigadier General Henry M. Robert

Chief of Engineers
(April 30, 1901-May 2, 1901)

Born May 2, 1837, in South Carolina, Henry Robert ranked No. 4 in the Class of 1857 at West Point. After receiving his commission in the Corps of Engineers, he taught at West Point and then was assigned duty in the West on road construction and fortification work. During the Civil War his duties were confined to construction work on the defenses of Washington and Philadelphia. From 1867 until his retirement in 1901 he served on river and harbor improvement throughout the United States. He was made brigadier general April 30, 1901, and appointed Chief of Engineers. He served until May 2, 1901, when he retired from the Army. He died May 1, 1923, at Hornell, N.Y. He became famous for his *Pocket Manual of Rules of Order,* a compendium of parliamentary law first published in 1876 and better known today as *Robert's Rules of Order.*

Brigadier General John W. Barlow

Chief of Engineers
(May 2, 1901-May 3, 1901)

Barlow was born in New York, June 26, 1838, and was graduated from West Point in May 1861. He was first commissioned in the Artillery, but transferred to the Engineers in July 1862. He served throughout the Civil War and was brevetted a lieutenant colonel for his gallant service in the Battle of Nashville, December 1864. From 1870 until 1874 he was General Sheridan's Chief Engineer in the Military District of Missouri. During this period he made scientific explorations of the headwaters of the Missouri and Yellowstone. His detailed reports became guides for emigrants. Colonel Barlow's civil works activities extended throughout the United States. He was on government duty placing monuments along the International Boundary between the United States and Mexico (1892-96). On May 2, 1901, he was commissioned brigadier general and appointed Chief of Engineers. The next day, May 3, 1901, he retired from the Army after 40 years of service. He died February 27, 1914, at Jerusalem, Palestine, at the age of 75.

Brigadier General George Lewis Gillespie, Jr.

Chief of Engineers

(May 3, 1901-January 23, 1904)

George Gillespie was born October 7, 1841, at Kingston, Tenn. He was graduated No. 2 in the Class of 1862 at West Point and appointed second lieutenant, Corps of Engineers and instructor of artillery at the Academy. Another Southerner who remained loyal to the Union, Gillespie joined the Army of the Potomac in September 1862 and commanded two companies of the engineer battalion which engaged in building fortifications and pontons throughout the Virginia campaigns until the Appomattox surrender. He distinguished himself at the battle of Fredericksburg and received the Medal of Honor for carrying dispatches through enemy lines under withering fire to Sheridan at Cold Harbor. He was Sheridan's Chief Engineer, Army of the Shenandoah and Mexican Border. After the Civil War, his outstanding seacoast construction included the famous lighthouse on Tillamook Rock in the Pacific Ocean. He served as chief of various divisions and districts and member of important boards and in 1898 was made Commander, Department of the East. While Chief of Engineers, he was acting Secretary of War (August 1901). He had charge of ceremonies at President McKinley's funeral and at laying the cornerstone of the War College Building (1903). He served as Assistant Chief of Staff, 1904-05. General Gillespie retired June 15, 1905, and died September 27, 1913, at Saratoga, N.Y.

Brigadier General Alexander Mackenzie

Chief of Engineers

(January 23, 1904-May 25, 1908)

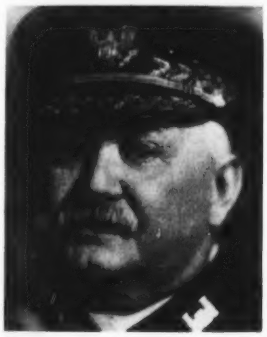
Born May 25, 1844, in Wisconsin, Alexander Mackenzie was graduated from West Point in the Class of 1864. Commissioned in the Corps of Engineers, he served with the Union Army, 1864-65. General Mackenzie had broad rivers and harbors engineering experience with the Corps. Most of his service was on such work, either in the field or in the Office of the Chief of Engineers at Washington. His most notable period of construction achievements was during the years 1880-95, when he developed the great Upper Mississippi River projects between St. Paul and the mouth of the Missouri River. Called to Washington in 1895, he became Assistant to the Chief of Engineers, in charge of all matters relating to rivers and harbors improvements. He was a member of the general staff corps and War College Board when appointed Chief of Engineers. Retired May 25, 1908, he was recalled to active duty in 1917 at age 73 as Division Engineer at Rock Island, Ill. General Mackenzie died March 21, 1921, at Washington, DC.

Brigadier General William Louis Marshall

Chief of Engineers

(July 2, 1908-June 11, 1910)

Born June 11, 1846, in Kentucky, a scion of the celebrated Virginia family of Chief Justice Marshall, young Marshall, at age 16, enlisted in the 10th Kentucky Cavalry, Union Army, in 1862. He was graduated at West Point, Class of 1868 and commissioned in the Corps of Engineers. Assistant engineer on the famous Wheeler Expedition (1872-76), Marshall covered thousands of miles on foot and horseback. He discovered Marshall Pass and served on Southern Mississippi River improvements (1876-82) and rivers and harbors work in the Chicago District, 1888-99. His skillful and original engineering of Hennepin Canal was notable and he developed novel and lasting methods of concrete and lock canal construction. Stationed at New York (1900-08), his bold and original genius further expressed itself on the Ambrose Channel project and in standardizing fortifications construction methods. He retired June 11, 1910, but his engineering reputation earned for him from President Taft a special appointment as consulting engineer to the Secretary of Interior. General Marshall died July 2, 1920 at Washington, DC.



Brigadier General William Herbert Bixby

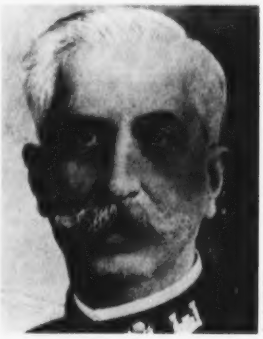
Chief of Engineers

(June 12, 1910-August 11, 1913)

Born December 27, 1849, at Charleston, Mass., Bixby was graduated from West Point, No. 1 in the Class of 1873 and commissioned in the Corps of Engineers. After serving with the engineer battalion at Willets Point and as Assistant Professor of Engineering at West Point, Bixby spent three years on professional duty in Europe and received the Order, Legion of Honor for assisting at French Army maneuvers. His important assignments during the next 28 years included: Chief, Rivers and Harbors and Fortifications Work, New England (1891-95); Detroit District (1902-04); at

Chicago (1905-07); and Chief Engineer, Department of Lakes (1908-10). General Bixby was made president of the Mississippi River Commission in 1908 and in 1917 and was a member of numerous boards, commissions and scientific societies. He retired August 11, 1913, and was recalled to service in 1917, as supervising engineer of the District Engineer offices in the Mississippi River Basin. He died September 29, 1928, at Washington, DC.

Brigadier General William Trent Rossell
Chief of Engineers
(August 12, 1913-October 11, 1913)


U.S. Army

Rossell was born in Alabama, October 11, 1849, the son and grandson of Army officers and was graduated from West Point, No. 3 in the Class of 1873. Commissioned in the Corps of Engineers, he served at Willets Point and as Assistant Professor of Engineering at West Point, 1873-80. Until appointment as Engineer Commissioner, DC, in 1892, Rossell was assigned to important rivers and harbors and fortifications work. He commanded the battalion and post at Willets Point in 1895. From 1895 to 1908 he was on rivers and harbors, fortifications and lighthouse assignments and was Division Engineer, Central Division (1908-09) and Eastern Division (and member of Boards of Engineers for Fortifications and for Rivers and Harbors) in 1909-13. He retired October 11, 1913. He was recalled to active service in 1917 as Chief, 3d New York and Puerto Rico districts. He served on highly important boards and was Division Engineer, Northeastern Division, when he again retired in 1918. General Rossell had a keen intellect and was held in high esteem by engineers in civil life. He died October 11, 1919, at New Brighton, New York.

Brigadier General Dan Christie Kingman
Chief of Engineers
(October 12, 1913-March 6, 1916)

Born March 6, 1852, at Dover, N.H., Kingman was graduated from West Point, No. 2 in the Class of 1875 and commissioned in the Corps of Engineers. He served at Willets Point, as instructor at West Point, as engineer officer of the Platte and as Chief, 4th District, Mississippi River. He received the thanks of the Louisiana legislature for "splendid service rendered" during the 1890 flood. He also served at Oswego, N.Y., on lake shore defenses and water-level observations (1890-95) and made a special report to Congress on proposed ship canals across New York State. During the next decade, he was on rivers and harbors and fortifications work in the Southeast and served as Consulting Engineer, New York State Barge Canal Survey. The Panama Canal was completed while he was Chief of Engineers. He retired March 6, 1916, and died November 14, 1916, at Atlantic City. General Kingman was buried with high military honors at Arlington National Cemetery. Among the pallbearers were Chief of Staff General Hugh L. Scott and two former Chiefs of Engineers, Generals Mackenzie and Bixby.

Major General William Murray Black
Chief of Engineers
(March 7, 1916-October 31, 1919)

Born December 8, 1855, at Lancaster, Pa., Black was graduated No. 1 in the West Point Class of 1877 and commissioned in the Corps of Engineers. In the Spanish-American War, he was Chief Engineer, 3d and 5th Army Corps. As Chief Engineer under General Wood (1899-1901), and six years later as advisor to the Cuban Department of Public Works, he transformed Havana into a modern, sanitary city. As Commandant, Black moved the Engineer School from Willets Point and re-established it at Washington Barracks, DC, (1901-03). After his return from Cuba in 1909, he was Division Engineer, Northeastern Division and chairman of a board to raise the *Maine*. Devoted to training young engineer officers in the art of war, General Black's greatest responsibility came as Chief of Engineers in World War I, in mobilizing, training and demobilizing over 300,000 military engineers. For this he was awarded the Distinguished Service Medal. He retired October 31, 1919, and died September 24, 1933, at Washington, DC.

Major General Lansing Hoskins Beach
Chief of Engineers
(February 10, 1920-June 18, 1924)

Born June 18, 1860, at Dubuque, Iowa, Beach was graduated from West Point in the Class of 1882 and commissioned in the Corps of Engineers. He served at Willets Point, had various assignments in the Middle West and Southwest and was instructor at West Point. He performed rivers and harbors work in 1894 and was assigned to the District of Columbia. He served as Engineer Commissioner of the District of Columbia, 1898-1901. During the next seven years he was on river and harbors and fortifications works and an instructor at various Army schools. He was Division Engineer, Gulf Division (1908-12) and Baltimore District Engineer (1912-15). After his four-year tour as Chief of Engineers, he retired as a major general June 18, 1924. After retirement, General Beach served as consulting engineer for various business interests in the United States and Mexico. He was past President, American Society of Military Engineers and a member of the International Water Commission from 1924 to 1930. He died April 2, 1945, at Pasadena, Calif.

Major General Harry Taylor
Chief of Engineers
(June 19, 1924-June 26, 1926)

Born June 26, 1862, at Tilton, N.H., Taylor was graduated from West Point in the Class of 1884 and commissioned in the Corps of Engineers. After various assignments in the East, Taylor served on fortifications and rivers and harbors construction work in Washington and Oregon, 1891-1900. Later he was on similar work in New England and New York. Transferred to the Philippines, he supervised all fortification work there during 1904-05. While in charge of North Atlantic seacoast defenses in 1906, he established the purchasing agency destined to become the later OCE Supply Section. General Taylor received the Distinguished Service Medal for services as Chief Engineer Officer, A.E.F. (1917-18). Although an outstanding fortifications engineer, he supervised many important river and harbor projects. Wilson Dam was completed while he was Chief. He was a member, French Legion of Honor and various American engineering societies. General Taylor retired June 26, 1926, died January 27, 1930, at Washington, DC, and is buried at Arlington National Cemetery.

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Major General Edgar Jadwin
Chief of Engineers
(June 27, 1926-August 7, 1929)

Born August 7, 1865, at Honesdale, Pa., Jadwin was graduated No. 1 in the West Point Class of 1890 and commissioned in the Corps of Engineers. He worked on fortifications and rivers and harbors (1890-97) and served as lieutenant colonel, 3d U.S. Volunteer Engineers, Spanish American War, in 1898. He was selected by General Goethals as an assistant in construction of the Panama Canal. He received the U.S. Distinguished Service Medal for services in World War I, was awarded the British Order of the Bath and elected Commander, French Legion of Honor. President Wilson appointed Jadwin to investigate conditions in Poland in 1919. From 1920 to 1929 he had charge of various engineer districts and served on important boards and as delegate to the World Engineers Congress at Tokyo. As Chief of Engineers he sponsored the plan for Mississippi River flood control, which was adopted by the Congress in March 1929. Jadwin was retired as a lieutenant general, August 7, 1929. He died at Gorgas Hospital, Canal Zone, March 2, 1931, and was buried at Arlington National Cemetery March 12, 1931, with impressive military honors.

Major General Lytle Brown
Chief of Engineers
(October 1, 1929-October 1, 1933)

Born November 22, 1872, at Nashville, Tenn., he was graduated in the West Point Class of 1898, and commissioned in the Corps of Engineers. He served at the Battle of San Juan and siege of Santiago, Cuba, 1898, with the engineer battalion at Willets Point (1899-1900), and in the Philippine Islands (1900-02). Subsequent assignments included his being instructor, West Point; company commander, 2d Battalion Engineers; District Engineer, Louisville; in the Mexican Punitive Expedition; District Engineer, Nashville-Chattanooga; Commander, 106th Engineers; and Chief, War Plans Division, General Staff, for which service he received the Distinguished Service Medal. After World War I he had many important assignments, including command of the 12th and 19th Brigades and duty in the Office of the Chief of Staff. After serving as Chief of Engineers, he commanded the Panama Canal Department, 1935-36. General Brown retired November 30, 1936. He died at Nashville, Tenn., May 3, 1951.

Major General Edward Murphy Markham
Chief of Engineers
(October 1, 1933-October 18, 1937)

Born July 6, 1877, at Troy, N.Y., Markham was graduated No. 5 in the West Point Class of 1899 and commissioned in the Corps of Engineers. He attended the Engineer School, Willets Point, N.Y., and served with 2d Battalion Engineers, Willets Point and the Philippines. He also served as assistant to Captain Sewell in the reconstruction of Washington Barracks, DC, and with an engineer battalion in Cuba on military mapping and road and bridge construction. He was District Engineer, Memphis and Professor of Practical Military Engineering, West Point. He served in France (1918-19) as Assistant Director, Division Light Railways and Roads and Chief Engineer, 3d Army, in Germany. After returning to the United States, he was District and Division Engineer in various locations and Commandant, Engineer School,

Ft. Humphreys, Va. Shortly after his services as Chief were ended, he made an extensive special survey in the Hawaiian Islands. General Markham retired February 28, 1938. He was N.Y. Public Works Commissioner in 1938 and later that year became President, Great Lakes Dredge & Dock Co., at Chicago. He died September 14, 1950.

Major General Julian Larcombe Schley

Chief of Engineers
(October 18, 1937-October 1, 1941)

Born February 23, 1880, at Savannah, Ga., Schley was graduated, West Point, Class of 1903 and commissioned in the Corps of Engineers. He and Douglas MacArthur had their first service with the 3d Battalion Engineers in the Philippines (1903-04). Schley later served with engineer troops in the United States and Cuba; at the Engineer School; and as an instructor at West Point; as Assistant Engineer, DC; and in charge of fortifications construction and river and harbor improvements, New Orleans. He was awarded the Distinguished Service Medal for services as Corps Engineer, 5th Army Corps (A.E.F.), and as Director of Purchase, General Staff and member W.D. Claims Board in 1919. After various engineer assignments in the United States, General Schley had distinguished service in the Canal Zone, 1928-32. He was Governor, Panama Canal and military adviser to the Republic of Panama; Commandant, Engineer School; and Chief of Engineers (1937-41). He retired September 30, 1941, and was recalled to active duty as Director of Transportation, Office of Coordinator of Inter-American Affairs. He died March 29, 1965.

Lieutenant General Eugene Reybold

Chief of Engineers
(October 1, 1941-October 4, 1945)

Eugene Reybold, born February 13, 1884, at Delaware City, Del., was distinguished as the World War II Chief of Engineers, who directed the largest Corps ever recruited in history. He was graduated from Delaware College in 1903, commissioned in the U.S. Coast Artillery Corps in 1908 and assigned to quartermaster and coast defense construction work. Stationed at Fort Monroe throughout World War I, he received the Distinguished Service Medal. He transferred to the Corps of Engineers in 1926 and served as District Engineer, Buffalo; as a member of the Board of Engineers for Rivers and Harbors; and as Southwestern Division Engineer. He fought great Mississippi-Ohio Valley floods. In 1940 he was made Assistant Chief of Staff (G-4). Appointed Chief of Engineers shortly before Pearl Harbor, General Reybold directed the Corps' tremendous activities throughout the war—being the first officer ever to rank as lieutenant general while Chief of Engineers. He was awarded an Oak Leaf Cluster by the Army and honorary degrees by various universities for service in World War II. He retired January 31, 1946, and died November 21, 1961, at Washington, DC.

Lieutenant General Raymond A. Wheeler

Chief of Engineers
(October 1, 1945-February 28, 1949)

Born July 31, 1885, at Peoria, Ill., Raymond Wheeler was graduated from the U.S. Military Academy, Class of 1911 and commissioned in the Corps of Engineers. He served with the Vera Cruz Expedition in 1914 and was the commander of a combat engineer regiment in World War I with the grade of colonel. From 1919 to 1941 he was assigned at home and abroad to both military and civil works duties of increasing responsibility. In November 1941 he was chief of mission to the Persian Gulf and in February 1942 was transferred to the China-Burma-India Theater as Commanding General of the Services of Supply. In October 1943 he was assigned to the Southeast Asia Command as principal administrative officer.

Before the end of World War II, he became the Deputy Supreme Commander of Southeast Asia and the Theater Commander of the India-Burma Theatre. He represented the United States at the Japanese surrender at Singapore. He died February 8, 1974. He received the following decorations: Distinguished Service Medal with two Oak Leaf Clusters, Silver Star, Legion of Merit and Air Medal.

Lieutenant General Lewis A. Pick

Chief of Engineers
(March 1, 1949-January 26, 1953)

Born in Virginia, November 18, 1890, Lewis Pick graduated from Virginia Polytechnic Institute in 1914. He received his Regular Army commission in the Corps of Engineers July 1, 1920. During World War I, General Pick had served with the 23d Engineers in France. His first Regular Army assignment was in San Francisco at the Presidio. He served in the Philippines from 1921 until 1923, when he became a student officer at Fort Humphreys, Va. He was District Engineer at New Orleans in 1928, when he became Professor of Military Science and Tactics at the Agricultural and Mechanical College of Texas. General Pick was graduated from the Army War College in 1939 and was named Division Engineer of the Missouri River Division in 1942. He was assigned to the China-Burma-India Theater of Operations in October 1943 and became distinguished as the builder

of the Ledo Road. After his return to the United States in 1945, he again became Division Engineer of the Missouri River Division. On March 1, 1949, he was appointed Chief of Engineers. He is widely known as the co-author of the Pick-Sloan Plan for controlling the water resources in the Missouri River basin. He died December 2, 1956, at Washington, DC.

Lieutenant General Samuel D. Sturgis, Jr.

Chief of Engineers
(March 17, 1953-September 30, 1956)

Born July 16, 1897, at St. Paul, Minn., General Sturgis came from an illustrious military family. Both his father and grandfather were West Point graduates and major generals. General Sturgis himself was graduated from West Point in 1918. As a young engineer officer he served on the Mexican border and in France. He then taught mathematics at West Point for four years. In 1926, he was ordered to the Philippines, where he served first as Adjutant and later was Commanding Officer of the 14th Engineers. During this three-year period, his strategical studies of the islands developed knowledge which he was to employ 18 years later when he returned to the Philippines in 1944 as Chief Engineer of General Krueger's Sixth Army. In February 1946, he returned to the United States to become Air Engineer of the United States Air Force. After a period of General Staff duty, he was made Division Engineer of the Missouri River Division. In 1951 he became the Commanding General of the 6th Armored Division and Fort Leonard Wood. In 1952 he was appointed Commanding General of the Communications Zone supporting the United States Army in Europe. He became Chief of Engineers March 17, 1953. He died July 5, 1964, at Washington, DC.

Lieutenant General Emerson C. Itschner

Chief of Engineers
(October 1, 1956-March 27, 1961)

Born in Illinois, July 1, 1903, Itschner was graduated from the U.S. Military Academy, Class of 1924, and commissioned in the Corps of Engineers. His first assignment was with the 13th Engineers at Fort Humphreys, Va. He was graduated from Cornell University in 1926 with a degree in Civil Engineering. General Itschner was assigned to duty with the Alaska Road Commission from 1927 to 1929. He then served with the 6th Engineers, at Fort Lawton, Wash., 1929-32. He was Assistant Professor of Military Science and Tactics, at Missouri School of Mines and he served as assistant to the Division Engineer, Upper Mississippi Valley Division and assistant to the District Engineer, St. Louis District. He served with troops 1940-41. In World War II, he was engineer of the Advance Section Communication Zone in Europe. During the first year and a half of the Korean War, he was engineer of the I Corps. He was Division Engineer, North Pacific 1952-53. From 1953 until being appointed Chief of Engineers, he served as Assistant Chief of Engineers for Civil Works. General Itschner retired in 1961.

Lieutenant General Walter K. Wilson, Jr.

Chief of Engineers
(May 19, 1961-July 1, 1965)

Walter Wilson was born at Fort Barrancas, Fla., August 26, 1906, son of the late Major General Walter K. Wilson. He was graduated from the U.S. Military Academy, Class of 1929 and commissioned in the Corps of Engineers. Prior to 1942, he served with troops, continued his military and engineering education, and served as instructor at West Point. During World War II, General Wilson served as Deputy Engineer-in-Chief with the South East Asia Command at New Delhi, India and Kandy, Ceylon. He became Commanding General, Advance Section, U.S. Forces, India-Burma Theater and Chief of Staff of the Chinese Army in India. Later, he took command of Intermediate and Base Sections and consolidated all three, commanding all ground forces remaining in the theater. He was District Engineer, St. Paul (1946); District Engineer, Mobile (1949); and Division Engineer, Mediterranean Division (1953). He took command of the 18th Engineer Brigade, Fort Leonard Wood, Mo., in 1955. He was moved from Assistant to Deputy Chief of Engineers for Military Construction in 1956. On August 31, 1960, General Wilson became Commanding General of the U.S. Army Engineer Center and Fort Belvoir and Commandant of the U.S. Army Engineer School. He retired as Chief of Engineers June 30, 1965. He held the Legion of Merit with Oak Leaf Cluster, the Soldier's Medal, the Army Commendation Ribbon, and the French Legion of Honor. He died in Mobile, Alabama, on December 6, 1985.

Lieutenant General William F. Cassidy

Chief of Engineers
(July 1, 1965-July 31, 1969)

Born on an Army post near Nome, Alaska, on August 28, 1908, William Cassidy was graduated from the U.S. Military Academy, Class of 1931, and commissioned in the Corps of Engineers. His early years in the Corps were spent with troops and civil works. During World War II, General Cassidy commanded engineer troops specializing in airfield construction. He was Deputy Chief, then Chief, War Plans, later Operations and Training Division, OCE, 1944-47. At the outbreak of the Korean conflict, he was ordered to Japan, where he was responsible for engineer supply. He served as Division Engineer, South Pacific Division, from 1955 to 1958 and was the Senior Logistics Advisor to the Republic of Korea Army, 1958-59. General Cassidy was in charge of Civil Works operations from September 1959 to March 1962 and was appointed Deputy Chief of Engineers in April 1962. On March 1, 1963, General Cassidy became the Commanding General of the U.S. Army Engineer Center and Fort Belvoir

and Commandant of the U.S. Army Engineer School. He became Chief of Engineers July 1, 1965. He was awarded the Legion of Merit with Oak Leaf Cluster, the Bronze Star, the United Nations Service Medal and the Presidential Citation (Republic of Korea), and was presented with the Distinguished Service Medal for exceptionally meritorious service during his four-year term as Chief of Engineers.

Lieutenant General Frederick J. Clarke

Chief of Engineers
(August 1, 1969-July 31, 1973)

Born in Little Falls, N.Y., March 1, 1915, Clarke was commissioned in the Army Corps of Engineers in 1937 following graduation from West Point. During World War II, he was a battalion commander overseas and later served in Washington, DC, with the Army Service Forces. General Clarke's post-war assignments were in the atomic energy field with the Manhattan District and the Atomic Energy Commission at Hanford, Wash. and at the Armed Forces Special Weapons Project at Sandia Base, Albuquerque, N.M. As the District Engineer of the Trans-East District of the Corps in the late 1950s, he was responsible for the military aid construction in Pakistan and Saudi Arabia and initiated transportation surveys in East Pakistan and Burma. General Clarke received a master's degree in Civil Engineering from Cornell University in 1940 and attended the Armed Forces Staff College, the National War College and the Advanced Management Program of the Graduate School of Business, Harvard University. He was Engineer Commissioner of the District of Columbia (1960-63), Director of Military Construction in the Office of the Chief of Engineers (1963-65), Commanding General of the U.S. Army Engineer Center and Commandant of the Engineer School, Fort Belvoir, Va., (1965-66) and Deputy Chief of Engineers (1966-69) after which he served as Chief of Engineers. General Clarke was awarded the Army Commendation Medal with two Oak Leaf Clusters, the Legion of Merit, the National Defense Service Medal and the Distinguished Service Medal.

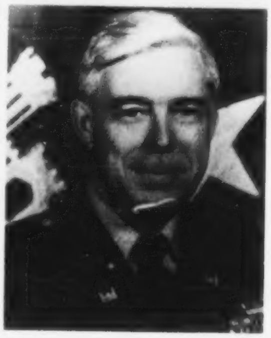
Lieutenant General William C. Gribble, Jr.

Chief of Engineers
(August 1, 1973-June 30, 1976)

Born in Ironwood, Mich., on May 24, 1917, Gribble received his commission in the Army Corps of Engineers in 1941 after being graduated from West Point. He commanded the 118th Engineer Combat Battalion, 43d Infantry Division; the U.S. Army Engineer Reactor Group; the Alaska Engineer District; and the North Central Engineer Division. He also served with the Atomic Energy Commission; as Director of the Army Nuclear Power Program; as Deputy Director for Military Construction in the Office of the Chief of Engineers; with the Army Materiel Command; on the Army Staff as the Deputy Chief of Research and Development and as the Deputy Assistant Chief of Staff for Force Development. In April 1969, General Gribble assumed command of the U.S. Army Engineer Center and Fort Belvoir and became Commandant of the U.S. Army Engineer School. He became Chief of Research and Development, Department of Army, in 1971 and Chief of Engineers in 1973. He received a Master of Science degree in physical science from the University of Chicago in 1948 and an honorary doctorate in engineering from Michigan Technological University. He also graduated from the Army Command and General Staff College and the National War College. He was a registered professional engineer in the District of Columbia and was a member of the Society of American Military Engineers and the American Defense Preparedness Association. He was also a member of the U.S. Committee on Large Dams, the Society of Naval Architects and Marine Engineers, and an honorary member of the United Kingdom Institute of Royal Engineers. General Gribble's decorations included the Distinguished Service Medal with Oak Leaf Cluster, the Legion of Merit with Oak Leaf Cluster, and the Brazilian Order of Military Merit. He died at Fort Belvoir, Virginia, on June 2, 1979.

Lieutenant General John W. Morris

Chief of Engineers
(July 1, 1976-September 30, 1980)



Lieutenant General John W. Morris is a native of Princess Anne, Md. and a 1943 graduate of the U.S. Military Academy, West Point. In July 1976 he became Chief of Engineers, U.S. Army Corps of Engineers, after serving a year as Deputy Chief. From 1972-75 he was Director of Civil Works. His first civil works assignment was as Deputy District Engineer for the Savannah District in 1952. Later, as Tulsa District Engineer, he initiated value engineering in the Corps and received a Presidential Citation from President Lyndon Johnson for management improvements. He directed water resources development and military construction as Division Engineer of the Missouri River Division, 1970-72. His command assignments include Commanding Officer, 8th Engineer Battalion, Korea and Commanding General of the 18th Engineer Brigade, Vietnam. General Morris holds a master's degree in civil engineering from the University of Iowa. He is a graduate of the Army Engineer School, Command and General Staff College and the Army War College. His numerous military awards include the Distinguished Service Medal, the Legion of Merit with three Oak Leaf Clusters, the Bronze Star, and the Air Medal. General Morris is a member of the Tau Beta Pi Professional Engineering Society, the American Institute of Architects, the U.S. Committee on Large

Dams and the Society of American Military Engineers. He is a fellow in the American Society of Civil Engineers and a registered professional engineer in Oklahoma. He was selected Construction's Man of the Year for 1977 by the *Engineering-News Record.*

Lieutenant General Joseph K. Bratton

Chief of Engineers
(October 1, 1980-September 14, 1984)

Lieutenant General Joseph K. Bratton was born on April 4, 1926, in St. Paul, Minnesota. He graduated third in the class of 1948 at the U.S. Military Academy, West Point, with a commission in the Corps of Engineers. His last assignments before becoming Chief of Engineers in October 1980 were as Division Engineer of the Corps' South Atlantic Division (1979-1980) and then briefly as Deputy Chief of Engineers. General Bratton's command assignments included the 24th Engineer Battalion with the 4th Armored Division in Germany and the 159th Engineer Group in Vietnam. He also held numerous staff assignments which included Director of Military Application, Department of Energy; Chief of Nuclear Activities, Supreme Headquarters of Allied Powers, Europe (SHAPE); Secretary to the Joint Chiefs of Staff; and Military Assistant to the Secretary of the Army. He received a master's degree in nuclear engineering from the Massachusetts Institute of Technology in 1959. He also graduated from the Army Command and General Staff College and the Army War College. He is a registered professional engineer in the state of Wisconsin and a member of the Society of American Military Engineers. His military awards include the Defense Distinguished Service Medal, the Army Distinguished Service Medal, the Legion of Merit (three awards), the Bronze Star Medal (two awards), the Joint Service Commendation Medal, the Air Medal (two awards) and the Army Commendation Medal (four awards).

Lieutenant General Elvin R. Heiberg III

Chief of Engineers
(September 14, 1984-)

Lieutenant General E. R. Heiberg III was born at Schofield Barracks, Honolulu, Hawaii. Following in the footsteps of his father and grandfather, he graduated from the U.S. Military Academy, West Point, in 1953. Thirty-one years later, in September 1984, he became Chief of Engineers and Commander, U.S. Army Corps of Engineers. General Heiberg's assignments in the Corps of Engineers have included District Engineer, New Orleans District; Division Engineer, Ohio River Division; and Director of the Civil Works Directorate, Office of the Chief of Engineers, from September 1979 to July 1982. He has also held staff positions in the Office of the Secretary of the Army and the Office of the Assistant Vice Chief of Staff, U.S. Army. In addition, he was a professor in the Social Sciences Department at West Point and served as Special Assistant and Executive Assistant to the Director, Office of Emergency Preparedness, under the Executive Office of the President. General Heiberg commanded the 4th Engineer Battalion, 4th Infantry Division in Vietnam and was Deputy Chief of Staff, Engineer, U.S. Army, Europe. He was Deputy Chief of Engineers from July 1982 to May 1983 and following that was Program Manager of the Ballistic Missile Defense Program serving under the Office of the Army Chief of Staff until his appointment as Chief of Engineers. During his career General Heiberg has earned three masters degrees, including one in civil engineering from the Massachusetts Institute of Technology. General Heiberg also graduated from the Army Command and General Staff College and the Industrial College of the Armed Forces. His military awards include the Distinguished Service Medal, Silver Star, three Legions of Merit, Distinguished Flying Cross, Bronze Star Medal, seven Air Medals, and two Army Commendation Medals.

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